UNIV. OF
TORONTO
LIBRARY

BINDING LIST JAN 1 1923

Technol
M
P

PUBLIC WORKS

INDEX

VOLUME L

JANUARY TO JUNE

1921

177841
3/2/23

MUNICIPAL JOURNAL AND ENGINEER
(INCORPORATED)
243 WEST 39th STREET
NEW YORK

PUBLIC WORKS

INDEX

VOLUME 50

JANUARY—JUNE

1921

TD
1
P8
v. 50

General Index

Adversity, Water Works Benefit by.525
Aggregate, Belt Conveyors for.....277
Aid for British Roads, Government. 30
, Types of Roads Receiving Federal 428
Alabama's Highway Bond Election Illegal 243
Highway Bonds 102, 137
Alkali upon Concrete, Effect of.....390
Anti-Strike Action, Promising.....241
Appraisal of Water Works Properties. 480
Appropriation Postponed, Federal Aid 245
Arch Centers Be Supported, How Can.531
Argentine Republic, Good Roads in..238
Asphalt Plant, Manhattan Borough... 21
Assessments in Newton, Sewer.....187
Atlanta Votes $8,850,000 Improvement Bonds 256
Atlantic City's High-Pressure Fire System 4
Baltimore Municipal Construction, $51,000,000 Provided for 350
Waster Disposal Report.....492
Base and Sub-Base Failures—Table.307
and Sub-Grade Failures 130
for Granite Blocks, Non-rigid...359
Bases, Flexible Pavement 93
for Pavements, Non-Rigid...111, 348
, Pavement 136
Bayonne Desires New Water Supply.265
Benefit by Adversity, Water Works.525
Bethlehem, Viaduct for 30
Bids High, Road 242
in Gary, Pavement.....324
Received, More Paving.....59
Bill, National Federation of Construction Industries Opposes Johnson Immigration 153
, $250,000,000 Public Works 411
Blasting a Ditch in Gravel.....8
Down Trees 288
Blocks, Non-Rigid Base for Granite.359
Boilers, Effect of Cleaning.....143
Bonds, Alabama's Highway.....102, 137
, Atlanta Votes $8,850,000 Improvement 256
by Misrepresentation, Obtaining..408
, Municipal 143
, Texas County Road.....176
Boston Needs More Water.....198
, Snow Removal in 174
Boulevard, Building the Du Pont...191
Boundaries, Municipal Utilities and Political 193
Bridge Construction Concrete.....541
Bridge Construction, Highway.....393
Erection, Novel Concrete.....446
Substructure Repairs Tempe....523
Superstructure Is Classified as Hand Rail Concrete, How Much of 227
, The Georgetown 203, 221, 238
Work, Fantastic 451
Bridges, Short-Span Highway...313, 350
Brindell Convicted 179
British Roads, Government Aid for.. 30
Bronx Borough, New York, Laying Reinforced Concrete Sewers in.493
Brooklyn, Avenue U Sewers..... 73
Budgets, Construction 282
Buffalo City and County Hog Farm for 208
, Filtration Plant Recommended for 264
Buffalo's Improved Water Supply.... 59
Builders' and Contractors' Get-Together Club Be Organized and Financed?, How Can a.....151, 175
Building Industry, Trade Schools Necessary for the.....198
Investigation 57
Operations, Many 523
Permits and Contracts in 1920..192
with Foundations on Wet Sand to be Underpinned?, How Can a Brick 415
Zones, Changes in New York's.. 92
Burned by Water Friction, Hose.... 76

Cal in Portland Cement, Effect of..278
California, Highway Shade Trees in.187
Roads, Federal Report on.....324
Canal Proposed, Another Isthmian..109
Care of Concrete Mixers, The.....437
Cast Iron Pipe, Modern..... 75
Cement and Water to a Concrete Mixer, Delivering.....509
, Effect of Cal in Portland.....278
Plants, for State-Owned 73
Census Figures, Some 1920..... 33
in Pennsylvania, Road Traffic....194
Centers Be Supported, How Can Arch.530
Certainties, Construction 501
Chicago, Mechanical Snow Loading in 165
, Street Paving in 194
, Street Work in.....148
Chicago's Paving Program.....295
Cincinnati, Street Cleaning in.....504
Cities, Finances of 265
, Paving in American.....282
City and County, Snow Fighting in.. 31
Pavements to Be Laid in 1921..283
Planning for Kansas City..... 95
Streets and Highway Pavements.135
Streets, Removing Snow from... 37
Classification, Special Mud Excavation 305
Cleaning Boilers, Effect of.....143
in St. Paul, Street..... 11
Cleveland's Submerged Sewage Outfalls 188
Club Be Organized and Financed?, How Can a Builders' and Contractors' Get-Together ...151, 175
Cofferdams, Drag-Line 372
Collection in England, Refuse..... 97
Records, Refuse 375
Colorado River, Power from..... 30
Columbus to Enlarge Filtration Plant 300
Commission, Economy by Kansas Highway 536
Commission Retires Its Consulting Engineers, Vehicular Tunnel..408
, The Indiana Highway.....238
Computing Parabolic Curves for Street Grades 373
Concrete a 2 in 1 Slope with a Slab Lining Having Few Joints, How to 287
, Coarse Sand in Road.....159
, Effect of Alkali upon.....390
, Effects of Organic Impurities on 425
, How Much of Bridge Superstructure Is Classified as Hand Rail 227
in Sea Water 374
Injured in Transit, Pavement...473
Job Mechanical, A 5, 26
Pavements, Reinforcing 137
Pavements ,Reinforcing 137
Sheet Piles Be Installed?, How Can 41
Tests on Earth 554
Concreting a Highway in Cold Weather Result of 426
, Rapid Road 67
Records, Good 219
Conservatism Desirable, Federal Business 375
Conspiracies, Fighting Construction. 81
Construction Budgets 282
Careers, Government 207
Certainties 501
Company's Encouraging Opinion, A Bid 81
, Concrete Bridge 541
Conditions Improving 526
Conspiracies, Fighting 81
Contract, Fixed Fee Form of Building 174
Contracts, Form of 344
Data, Unusual Engineering 343
, Day Labor Highway 208
, Difficult Swamp Road Construction 49
, Economical Plant on Concrete Road 171
Equipment During the Winter?, What Disposition is Best for.. 82
, Federal Aid Highway.....408
, Highway Bridge 393
in Kokomo, Ind., Sewer..... 89
in Ohio, Road 548
in South Chicago, Concrete Highway 523
in 1920 and 1921..... 81
Industries Opposes Johnson Immigration Bill, National Federation of 153
Lectures, Special Engineering...500
Methods and Equipment, Flexibility of 223
Methods and Plant, Field.....551
Methods, Important Development of 193
Methods, Modifying 169
, North Carolina Highway..... 60
Operations, Obstacles to..58, 81, 171
Organization Be Utilized During Winter Shut-Down?, How Can a General 103
Out ook, Building 397
Prices Are High, Why Highway.396
, Traffic Justification for Highway 396
?, What Are the Advantages, Disadvantages and Uses of Limestone in Highway.....360
, $51,000,000 Provided for Baltimore Municipal 350
Consumers, Educating Water Works.258
Contract, A Workable Form of.....361
, Elements of an Attractive..... 31
, Fixed Fee Form of Building Construction 174
Forms, A Choice of 347
, Installation for a $700,000 Concrete Road 144
, New Forms of 9
No. 26, Delaware State Road....344
Contractors, Engineers and 362
Contractors' Get-Together Club Be Organized and Financed?, How Can a Builders' and.....175, 151
Contracts, Cost-Plus 80
, Forms of Construction.....344
Held Up, Ohio State Road 166
in 1920, Building Permits and....192
Let Pennsylvania Highway.....378
, What Are the Essentials of Cost Keeping on 382
Control by Small Dams, Flood..... 51
Convention, American Water Works, 527, 546
Conveyors for Aggregate, Belt.....277
Copper Sulphate in Kansas City Reservoir, Use of 260
Cost Keeping on Contracts, What Are the Essentials of...../382
of Road Grading in Nebraska, Low 518
of Tunnel Rock Excavation, The. 13
Cost-Plus Contracts 80
Costs, Distributing Road Construction 323
in Oregon, Increased Highway..327
on Montana Roads, Engineering.320
, Some Recent Highway.....252
Council on Standardization.....552
Counties Paving Materials in Various 458, 505, 534
Country Roads, Snow Removal from 60
, Snow Fighting in City and.... 31
Court Powerless to Compel Sewerage.405
Cracks in Concrete Pavements Near Culverts, Preventing 326
Creates Park to Save Tree..... 34
Culvert for Park, Rustic.....447
Culverts, Preventing Cracks in Concrete Pavements Near.....326

Curves for Street Grades, Computing Parabolic 373
Cushions for Block Pavements, Mortar 525

Dam, Completing Germantown.....183
Proposed in the West, Two Large203
Dams, Flood Control by Small..... 51
Data, Importance of Run-Off.....479
of Fine Screen and Imhoff Tanks, Operating 370
on Rates, Finances and Labor, Tabulated 480
, Our Tabulated Pavement.....137
, Unusual Engineering Construction 343
Delaware Highway Designs and Specifications 261
State Road Contract No. 26.....344
Delivering Cement and Water to a Concrete Mixer 509
Department, South Carolina Highway 335
Uses Machinery, Water 522
Design, Important Features of Highway 499
Designing Roads, Economy in.....499
Designs and Specifications, Delaware Highway 261
Destroys Concrete Roads, Sugar Beet Sap 509
Deterioration of Water Plants, War..379
Dinner, Sanitary Engineers' 102
Disposal at Middletown, Garbage....222
at Worcester, Mass., Sewage....421
in Passaic, Refuse 367
, Liability of Municipality for Nuisance in Garbage 354
of Municipal Refuse 282
, Toledo's Garbage 263
Disposition is Best for Construction Equipment Durin gthe Winter?, What 82
Distinction, A Notable Engineering..150
Ditch in Gravel, Blasting a..... 8
Dorr System, Treating Sewage by the 52
Drainage in Port Arthur 172
of Highways, Location, Grading and 325
, Road Improvement and, Tab es.327
Structures in Giles County, Road 345
Dredging Started, Port Newark.....554
Duluth Water and Light Notes.....276
Duluth's Water Scare 29
Du Pont Boulevard, Building the...191

Earthcrete Road 431
Economy by Kansas Highway Commission 536
Economy in Designing Roads.....499
Efficiency, Determination of Pump.. 56
, Increasing Labor's 9
Means Profit on Small Jobs.....376
El Paso Irrigation Project..... 64
Employees, Equitable Pay for Federal 411
Engine Pumps Public Water Supply Fire 449
Engineering Distinction, A Notable..150
Society, A Russian-American.....102
Engineers and Contractors.....362
for Public Positions 329
, Vehicular Tunnel Commission Retires Its Consulting.....408
Wanted for California Bureau of Architecture 502
Wanted for Reclamation Service.376
Engineers' Dinner, Sanitary 102
England, Refuse Collection in..... 97
English Sewage Treatment, Notes on 24
Equipment During the Winter?, What Disposition Is Best for Construction 82
, Flexibility of Construction Methods and 223
Europe, Civic Tour of 256
, Water Works Notes in..... 51
Excavated and Loaded in Trucks?, How Can Beach Sand Be Most Economically 211
Excavation Classification, Special Mud 305
, The Cost of Tunnel Rock..... 13
Expenditure, Graphical Illustration of Municipal 78
Extermination Along Highways, Mosquito 347
Extortioners, A Good Beginning on.169

Failures, Base and Sub-Base, Tables.307
, Base and Sub-Grade 130
Farm for Buffalo, City and County Hog 208
Fastenings, Wire Rope 64
Federal Aid Appropriation Postponed.245
Fees, Automobile 323
Fighting in City and Country, Snow 31
Filter, A Home-Made Feed-Water..450
?, How Can a Small Quantity of Fine Sand Be Graded for Use in a 244
Filters for Small Sewage Plants, Sand 275
, Operating the St. Louis 10
Filtration Plant, Columbus to Enlarge 300
Plant, Financing Sacramento's.. 72
Plant Recommended for Buffa.o.264
Plants, Ineffectively Operated...479
, Water 296
Finances and Labor, Tabulated Data on Rates, ...480
—Labor, Meter Rates—Table..481
of Cities 265
Financing Sacramento's Filtration Plant 72
Fire System, Atlantic City's High-Pressure 4
Flood Control by Small Dams 51
Florida State Highways 449
Fumes, Durability of Metal Irrigation 77
, Protecting Metal 148
Form Economy for Concrete Reservoirs 395
of Contract, A Workable 361
Forms, A Choice of Contract.....347
of Contract, New 9
Foundations, Advantages of Bituminous Concrete 279
Friction, Hose Burned by Water..... 76

Galveston's Sea Wall 63
Garbage Collection in Trenton, N. J., Package 428
Disposal at Middletown.....222
Disposal, Toledo's 263
Gary, Pavement Bids in 324
Georgetown Bridge, The....203, 221, 238
Germantown Dam, Completing.....183
Goldsboro Street Paving in.....118
Government Aid for British Roads.. 30
Construction Careers 207
Threatened, Scientific Research by Federal 8
Graded for Use in a Filter?, How Can a Small Quantity of Fine Sand Be 244
Grades, Computing Parabolic Curves for Street 373
Grading and Drainage of Highways, Location, ...325
in Nebraska, Low Cost of Road..518
Road with Tractors and Wheel Scrapers 406
Gravel, Blasting a Ditch in..... 8
from Car to Concrete Mixer?, What Are the Best Methods of Handling 435, 456
Plant, A Traveling 92

Handling Gravel from Car to Concrete Mixer?, What Are the Best Methods of 435, 456
Harbor, New Orleans Inner.....446
Highway Bonds, Alabama's 102, 137
Bridges, Short-Span 313, 350
Building Annually 5,000 Miles of American 502
Commission, North Carolina's....268
Commission, Economy by Kansas.536
Commission, The Indiana 238
Completed, A 117-Mile Section of Concrete 40
Construction, Day Labor 208
Construction, Federal Aid.....408
Construction in South Chicago, Contracts for 523
Construction, North Carolina..... 60
Construction Prices Are High, Why 396
Construction, Traffic Justification for 396
Construction?, What Are the Advantages, Disadvantages and Uses of Limestone in.....360
Contracts Let, Pennsylvania 378
Costs in Oregon, Increased.....327
Costs, Some Recent 252
Department, South Carolina.....335
Design, Important Features of..499
Designs and Specification, Delaware 261
, Duplex Concrete 536
, Ideal Section of Lincoln 171
in Cold Weather, Result of Concreting a 426
in Illinois, Constructing a Brick.426
Notes, Oregon State 377
Pavements, City Streets and....135
Prices, Recent 397
Problem, Practical Solution of a.324
Specifications, Improved 391
Specifications, State 348
Supervision, a Costly Protest Against Inefficient 257
, Surfacing on Lincoln 265
Testing Department Oregon....446
, The Illinois Experimental..115, 166
, The Mount Pleasant 206
Traffic 237
Work, Pennsylvania 457
Work, Specifications for Massachusetts State 176
Highways, Extension of New York State 102
, Florida State 449
, Lighting 322
, Location, Grading and Drainage of 325
, Wisconsin State 12
Hog Farm for Buffalo, City and County 208
Honored by the Chinese Government, Dr. Waddell 348
Hose Burned by Water Friction..... 76
Hydro-Electric Plant, Skagit River.219
Illegal, Alabama's Highway Bond Election 243
Illinois, Constructing a Brick Highway in 426
Experimental Highway, The..115, 166
Federal Aid Roads 162
Illustration of Municipal Expenditure, Graphical 78
Immigrants Needed, More 32
Immigration Bill, National Federation of Construction Industries Maximum 526
Opposes Johnson 153
Legislation, Undesirab.e 397
Notes 15, 43, 153
Improvement and Drainage, Road—Tables 327
Bonds, Atlanta Votes $8,850,000..256
for Washington, D. C., Water...518
, Kansas City's Water Supply 76
Improvements in Toledo's Sewerage Designing 518, 541
Improvements in Trenton Water Purification 341
Impurities on Concrete, Effects of Organic 425
Increases, How Water Works Met Cost 520
Indiana Concrete Road Specifications.148
Highway Commission, The.....238
Road Law, Amending 205
Roads, Patrol Maintenance for..208
Indictments Expected, 500 153
Injunction, Passaic Valley Sewer 208, 264
Injured in Transit, Pavement Concrete 473
Installed?, How Can Concrete Sheet Piles Be? 41
How Can Submerged Pipes Be.. 65
Insurance Strike 242
Intake, Boosting a Water Works....410
Investigation, Building 57
Iowa, Complete Road Plant in.....317
Irrigation Fumes, Durability of Metal 77
Project, El Paso 64
Project for Manila 104
Isthmian Canal Proposed, Another..100

Japan, Bituminous Paving for.....411
Jersey City, Improved Heavy Traffic Pavements in 423
Job Mechanical, A Concrete..... 5, 26
Justification for Highway Construction, Traffic 396

Kansas City, City Planning for.... 95
City Reservoir, Use of Copper Sulphate in 260
City Water Supply 252
City's Water Supply Improvement 76
, Farmers Oppose Good Roads in.174
Highway Commission, Economy by 536
Kokomo, Ind., Sewer Construction in 89

Labor Conditions—Table 309
Efficiency, Increasing 9
for Public Works 121
in the United States, Unskilled..122
in 1921 135
, Meter Rates—Finances—Table .481
Notes 83
Situation, The 303
, Tabulated Data on Rates, Finances and 480
Lancaster's Water Main, Break in...143
Law, Amending Indiana Road.....205
Lectures, Special Engineering Construction 500
Legislation, Undesirable Immigration 397
Lexington, Sewage Treatment at.248, 348
Liability of Municipality for Nuisance in Garbage Disposal....354
Light Notes, Duluth Water and.....276
Lighting Highways 322
Limestone in Highway Construction?, What Are the Advantages, Disadvantages and Uses of 360
Lincoln Highway, Ideal Section of..171
Linden Street Sewer Tunnel.....254
Lining a 20-Foot Well, 50 Feet Deep.507
, Advantages of Pre-Cast Tunne'.257
Having Few Joints, How to Concrete a 2 in 1 Slope with a Slab.287
Loaded in Trucks?, How Can Beach Sand Be Most Economically Excavated and 211
Location, Grading and Drainage of Highways 325
London Boroughs, Refuse Disposal in 503
Lumber Sales Large Increase of.....194
Macadam by the Cold Patch Method, Repairing Bituminous 533

Machine, Lowering Water Main with Trenching 253
Machinery, Water Department Uses..522
Macon, Patching Concrete Pavements in 379
Main, Break in Lancaster's Water...143
with Trenching Machine, Lowering Water 253
Mains, Duplicate Supply 427
in Service, How to Move Pipe...555
Maintenance for Indiana Roads, Patrol 208
in New York, Gang vs. Patrol...343
in Springfield, Water 500
Modern Road Building and...359
Urged by the President, Road...347
Manhattan Borough Asphalt Plant.. 21
Manholes, Payment for Sewer.....105
Manila, Irrigation Project for.....104
Masonry Structures 362
Massachusetts Roads, Reinforced Concrete for 263
State Highway Work, Specifications for 176
Materials in Various Counties, Paving 458, 505, 534
, State Manufacture of Road...137
Measuring the Level of Liquids, Outfit for 478
Mechical, A Concrete Job.....5, 26
Medal for Third Time, Dr. Waddell Received Norman 150
Meter Maintenance, Water 208
Methods and Equipment, Flexibility of Construction 223
Middletown, Garbage Disposal at....222
Milwaukee, Water Works 173
Mixer, Delivering Cement and Water to a Concrete for Jap Tunnel, Pneumatic Concrete 452
Mixers from Central Storage Plants, Serving Concrete Paving.....454
, The Care of Concrete 437

Montana Roads, Engineering Costs on 320
Mosquito Extermination Along Highways 347
Move Pipe Mains in Service, How to 555
Mount Pleasant Highway, The.....206
Municipal Bonds 149
Development of Hydro-Electric Power 194
Expenditure, Graphical Illustration of 78
Street Cleaning, Philadelphia Begins 77
Utilities and Political Boundaries 193
Waste of Water....480
Nebraska, Low Cost of Road Grading in 518
Newark N. J., Repairing a Wood Block Pavement in 515

New Bedford Water Works Notes..394
New England Road Builders Ask Relief 224
Road Builders' Association 102
New Hampshire Gravel Roads in....448
New Jersey State Road, Heavy Work on a 443
Water Problem, Solving A.....29
New London, Water Revenues in.....524
New Orleans Inner Harbor.....446
Newton, Sewer Assessments in.....187
New York City Transit.....279
City's Preparations for Snow Removal 95
, Development of the Port of.... 91
Dry Dock Corporation's Plant....163
, Gang vs. Patrol Maintenance in.343
Harbor Dry Dock Corporation's Plant 141
Loses Passaic Valley Suit 430
State Highways, Extension to..102
Transportation Lines, Alarming Deterioration of 192
New York's Building Zones, Changes in 92
Water Supply, World's Largest Tunnel for 465, 496
North Carolina's Highway Commission 268
North Carolina Highway Construction 60
Notes Oregon State Highway.....377
Nuisance in Garbage Disposal, Liability of Municipality for.....354

Obstacles to Construction Operations 58
Ohio, Road Construction in.....548
Ohio State Road Contracts Held Up..166
Oil Out of Sewers, To Keep.....437
Operating a True Siphon.....475
Operations, Obstacles to Building... 58
, Obstacles to Construction..... 81
Opinion, A Big Construction Company's Encouraging 81
Oregon Highway Testing Department 446
, Increased Highway Costs in...327
State Highway Notes 377
Outfit for Measuring the Level of Liquids 478
Outlook, Building Construction.....397
Overlooked, Points 57

Park to Save Tree, Creates..... 34
Partnership in Water Supply, Municipal 256
Passaic, Refuse Disposal in.....367
Valley Sewer Injunction....208, 264
Valley Suit, New York Loses....430
Patching Concrete Pavements in Macon 379
Pavement Bases 136
Bases, Flexible 93
Bids in Gary 324
Data, Our Tabulated 137
Per Day, Laying 2,210 Square Feet of 524
Laid During 1920, Table..195, 209, 225
in Newark, N. J., Repairing a Wood Block 515
, Pre-Cast Concrete Slab.....319
, Reinforcing Concrete 119
Specifications of the A. S. M. I.... 95
Pavements, City Streets and Highway 135
in Jersey City, Improved Heavy Traffic 423
in Macon, Patching Concrete...379
Laid During 1920—A Correction.280
Laid During 1920—Table 155, 176, 266, 308
, Mortar Cushions for Block.....525
Near Culverts, Preventing Cracks in Concrete 326
, Non-Rigid Bases for 111, 348
Permissible, Patented 243
, Reinforcing Concrete 137
To Be Laid in 1921 City....283
with Lugless Brick, Bituminous Filled Brick 298
Paving Bids Received, More.....59
for Japan, Bituminous.....411
in American Cities.....232
in Chicago, Street 194
in Goldsboro, Street 118
Materials in Various Counties 458, 505, 534
Program, Chicago's 205
Program, Philadelphia's Big.....417
Pay for Federal Employees, Equitable 411
, The User Should 451
Payment for Sewer Manholes.....105
Pennsylvania Highway Contracts Let 378
Highway Work 457
, Road Traffic Census in....194
Road Work to Begin.....300
Permits and Contracts in 1920, Building 192
Philadelphia Begins Municipal Street Cleaning 77
, Street Cleaning in 410
Philadelphia's Big Paving Program.417
Pile, Loading Test on a Bridge Foundation 411
Piles Be Installed, How Can Concrete Sheet 41
Pipe?, How to Unjoint and Handle Three Miles of Lead-Joint, Small-Size Cast Iron.....197
Mains in Service, How to Move..555
, Modern Cast Iron 75
Welding, Oxyacetylene Torch for.549
Pipes Be Installed, How Can Submerged Water 65
, Service Strength of Sewer.....146
Planning for Kansas City, City..... 95
Plans and Specifications, Indefinite..223
Plant A Traveling Gravel.....92
, Columbus to Enlarge Filtration.300
, Financing Sacramento's Filtration 72
for Bergen County, Road Material's Storage 302
in Iowa, Complete Road.....317
, Manhattan Borough Asphalt... 21
, New York Dry Dock Corporation's 163
, New York Harbor Dry Dock Corporation's 141
on Concrete Road Construction, Economical 171
, Skagit River Hydro-Electric..219
Plants, For State-Owned Cement.... 73
, Ineffectively Operated Filtration 479
, Itinerant Concrete Mixing.....297
, Power for Public Utility..... 76
, Pumps for Small Water.....427
, Sand Filters for Small Sewage..275
, War Deterioration of Water....379
Poles, Preservative Treatment of Wood 63
Port Arthur, Drainage in.....172
Arthur, Street Work in.....120
Newark Dredging Started.....554
of New York, Development of the 91
Power for Public Utility Plants..... 76
from Colorado River.....30
in San Joaquin Valley, Water... 4
, Municipal Development of Hydro-Electric 194
Prices Are High, Why Highway Construction 396
, Recent Highway 397
Problem, Practical Solution of a Highway 324
Process, Present Status of Activated Sludge 356
Profit on Small Jobs, Efficiency Means 376
Program, Philadelphia's Big Paving.417
Properties, Appraisal of Water Works 480
Public Positions, Engineers for.....429
Work to Relieve Unemployment.305
Works Bill, $250,000,000.....471
Works in 1920, Salt Lake City's.174
Works, Labor for 121
Publicity for Public Works.....430
Pump Efficiency, Determination of.. 56
, Repairing Water Works System.277
Pumps at St. Paul, Electrically Driven Centrifugal 71
For Small Water Plants.....427
Public Water Supply, Fire Engine 449
Purification, Improvements in Trenton Water 341

Quicksand 98

Railroad Relocation, Costly 273
Rainfall and Runoff, Relations Between 472
Ranger's Water Supply 56
Rates, Finances and Labor, Tabulated Data on 480
—Finances—Labor, Meter Table.481
for Small Minnesota Villages, Water 276
Reclamation Service, Engineers Wanted for 376
Records, Refuse Collection.....375
Reduction, General Wage 408
Uncertainties, Garbage 409
Refuse, Collecting 241
Collection in England 97
Collection Records 375
Collection, Trailers in 235
Collection, Wasteful 219
Disposal in London Boroughs...503
Disposal in Passaic 367
, Disposal of Municipal.....282
Registration Areas, Growth of.....526
Reinforcing Concrete Pavement.....119
Concrete Pavements 137
Relocation, Costly Railroad.....273
Removal, Mechanical Snow.....233
, New York City's Preparations for Snow 95
Repairing Bituminous Macadam by the Cold Patch Method.....538
Repairing Water Works Steam Pump.277
Wood Block Pavement in Newark, N. J. 515
Repairs, Tempe Bridge Substructure.523
Report on California Roads, Federal.324
Reports and What They Should Contain, Water Works 473
Research by Federal Government Threatened, Scientific 8
Reservoir, Large Reinforced Concrete Covered 389
Roof for Recreation 518
, Use of Copper Sulphate in Kansas City 260
Reservoirs, Form Economy for Concrete 395
Restrictions, Excessive Motor Truck Taxation and 549
Revenues in New London, Water....524
Rhode Island Sewerage District, For a 224
Ridgway Honored, Robert 530
Road Bids High.....243
, Bifurcated Concrete 296
Bonds, Texas County 176
Builders Ask Relief, New England 224
Builders' Association, New England 102
Builders' Truck Turntable..... 50
Building and Maintenance, Modern 359
Concreting, Rapid 67
Construction Costs, Distributing.323
Construction, Difficult Swamp... 49
Construction, Economical Plant on Concrete 171
Construction in Ohio 548
Contract, Installation for a $700,000 Concrete 144
, Earthcrete 431
for New York—New Jersey Tunnel 243
, Heavy Work on a New Jersey State 443
Improvement and Drainage—Tables 327
Law, Amending Indiana.....205
Materials, State Manufacture of.137
Plant in Iowa, Complete.....317
Specifications, Indiana Concrete.148
Traffic Census in Pennsylvania..194
with Tractors and Wheel Scrapers, Grading 406
Work, Federal Aid 329
Work in View, No End to.....323
Work in 1920 and 1921—Table 336, 380

Work to Begin, Pennsylvania...300
Roads, A Country Without.....234
, Economy in Designing.....499
, Engineering Costs on Montana.320
, Everlasting 323
, Federal Report on California...324
, Government Aid for British... 30
, Illinois Federal Aid 162
in Argentine Republic, Good....258
in Kansas, Farmers Oppose Good.174
in New Hampshire, Gravel.....448
, Patrol Maintenance for Indiana 208
Receiving Federal Aid, Types of.428
, Reinforced Concrete for Massachusetts 268
, Snow Removal from Country... 60
, Sugar Beet Sap Destroys Concrete 509
, Types of Federal Aid 429
Wider, Making Narrow.....318
Rock Excavation, The Cost of Tunnel 13
, Joseph 150
Rope Fastenings, Wire 64
Run-off Data, Importance of.....479
, Relations Between Rainfall and.472
Russian-American Engineering Society, A 102
Salt Lake City's Public Works in 1920 174
Sand Be Graded for Use in a Filter?, How Can a Small Quantity of Fine 244
Be Most Economically Excavated and Loaded in Trucks?, How Can Beach 211
in Road Concrete, Coarse.....150
San Francisco Votes Against Purchasing Water Works.....264
Water Works, To Vote on Purchase of 174
San Joaquin Valley, Water Power in
Sap Destroys Concrete Roads, Sugar Beet 509
Save Tree, Creates Park to..... 34
Schools Necessary for the Building Industry, Trade 198
Scrapers, Grading Road with Tractors and Wheel 406
Screen and Imhoff Tanks, Operating Data of Fine 370
Sewage by the Dorr System, Treating 52
Disposal at Worcester, Mass....421
Outfalls, C eveland's Submerged.188
Plants, Sand Filters for Small...275
Treatment at Lexington....249, 348
Treatment, Notes on English.... 24
Sewer Assessments in Newton.....187
Construction in Kokomo, Ind....89
Injunction, Passaic Valley...208, 264
Manholes, Payment for 105
, Ocean Avenue Storm.....
Pipes Service Strength of.....146
Tunnel, Linden Street 217, 254
Sewerage, Court Powerless to Compel 405
Designing Improvements in Toledo's 518, 544
District, For a Rhode Is'and....224
Sewers, Brooklyn, Avenue U..... 73
in Bronx Borough, New York, Laying Reinforced Concrete...403
, Strength of 149
, Substitutes for 293, 358
, To Keep Oil Out of.....437
, What?, Before 301
Sheppard, Frederick William.....179
Shut-Down?, How Can A General Construction Organization Be Utilized During Winter 103
Simplifying Zoning 35
Siphon, Operating a True.....475
Sling, An Automatic Release.....253
Slope with a Slab Lining Having Few Joints, How to Concrete a 2 in 1 287
Sludge Process, Present Status of Activated 356
Snow Fighting in City and Country. 31
from City Streets, Removing... 37
Handling Apparatus 193
Loading in Chicago, Mechanical.165
Removal from Country Roads.....60
Removal in Boston.....174
Removal, Mechanical 233
Removal, New York City's Preparations for 95
Society, A Russian-American Engineering 102
Solution of a Highway Problem, Practical 324
South Carolina Highway Department.335
South Chicago, Concrete Highway Construction in 523
Spans, Constructing Short Highway.395
Specifications, Delaware Highway Designs and 261
for Massachusetts State Highway Work 176
, Improved Highway 301
, Indefinite Plans and 223
, Indiana Concrete Road 148
of the A. S. M. I. Pavement..... 95
, State Highway 348
Springfield, Water Maintenance in...500
Standardization, Council on 552
State Highway Specifications.....348
Road Work in 1920 and 1921....336
State-Owned Cement Plants, For.... 73
Staten Is and Tunnel, The.....384
Storage Plant for Bergen County, Road Materials 302
Plants, Serving Concrete Paving Mixers from Central 454
Street Cleaning in Cincinnati....504
Cleaning in Philadelphia 410
Cleaning in St. Paul 11
Cleaning, Philadelphia Begins Municipal 77
Force, Winter Work for the.....316
Work in Chicago 148
Work in Port Arthur 120
Work in Topeka, 1921 194
Streets and Highway Pavements, City 155
, Removing Snow from City.... 37
Strike Insurance 242
Structures in Giles County, Road Drainage 345
, Masonry 362
St. Louis Filters, Operating the..... 10
Transit System, The 220
St. Paul, Electrically Driven Centrifugal Pumps at 71
, Street Cleaning in 11
Sub-Base Failures, Base and Table..307
Sub-Grade Failures, Base and.....130
Substitutes for Sewers.....293, 358
Substructure Repairs, Tempe Bridge.523
Suit, New York Loses Passaic Valley 430
Superstructure Is Classified as Hand Rail Concrete?, How Much of Bridge 227
Supervision, A Costly Protest Against Inefficient Highway 257
Supply, Buffalo's Improved Water... 59
, Ranger's Water 56
Supported?, How Can Arch Centers Be 531
Surfacing on Lincoln Highway.....225
Swamp Road Construction, Difficult 49
Sweepers, Some Observations and Facts Concerning Motor.....159
Tanks, Operating Date of Fine Screen and Imhoff 370
Taxation and Restrictions, Excessive Motor Truck 549
Taxing Motor Traffic.....551
Technical Papers, Writing for.....207
Test on a Bridge Foundation Pile, Loading 411
Tests Earth in Concrete 554
Texas County Road Bonds.....176
Toledo's Garbage Disposal.....263
Sewerage Designing Improvement in 518, 544
Topeka, 1921 Street Work in.....194
Torch for Pipe Welding, Oxyacetylene 594
Truck Taxation and Restrictions, Excessive Motor 549
Tour of Europe, Civic 256
Tractors and Wheel Scrapers, Grading Road with 406
Traffic Census in Pennsylvania, Road.194
, Highway 237
Justification for Highway Construction 396
, Taxing Motor 551
Trailers in Refuse Collection.....225
Transit, New York City 279
, Pavement Concrete Injured in.473
System, The St. Louis.....220
Transportation Lines, Alarming Deterioration of New York.....192
, Winter 170
Treating Sewage by the Dorr System 52
Treatment at Lexington, Sewage....348
, Notes on English Sewage..... 24
of Wood Poles, Preservative..... 63
Tree, Creates Park to Save..... 34
Trees, Blasting Down.....288
in California, Highway Shade...187
Trenching in Wet Ground..... 80
Machines, Lowering Water Main with 253
Trenton, N. J., Package Garbage Collection in 428
Water Purification, Improvements in 341
Trolleys, Trackless 455
Tunnel for New York's Water Supply, World's Longest 465, 496
, Linden Street Sewer.....217, 254
Lining, Advantages of Pre-Cast.257
, Pneumatic Concrete Mixer for Jap 452
, Road for New York-New Jersey.243
Rock Excavation, The Cost of... 13
, The Staten Island.....384
Tunneling, Up to Date.....501
Turntable, Road Builders' Truck.... 50
Typhoid in West Virginia, Water-Borne 476
Valves, Inspecting Water Works...242
Viaduct for Bethlehem 30
Villages Water Rates for Small Minnesota 276
Waddell Honored by the Chinese Government, Dr. 348
Receives Norman Medal for Third Time, Dr. 150
Wage Reduction, General 408
Wages, Reducing Construction.....301
Wall, Galveston's Sea 63
Wardwell, F. S. 150
Washington, D. C., Water Improvement for 518
Waste Disposal Report, Baltimore...493
of Water, Municipal 489
Water and Light Notes, Duluth.....276
, Boston Needs More.....198
, Concrete in Sea 374
Department Uses Machinery.....522
Filtration 296
Improvement for Washington, D. C. 518
Main, Break in Lancaster's.....143
Main with Trenching Machine, Lowering 253
Maintenance in Springfield.....500
Meter Maintenance 253
, Municipal Waste of 489
Plants, War Deterioration of....379
Problem, Solving a New Jersey.. 29
Revenues in New London.....524
Supply, Bayonne Desires New...265
Supply, Buffalo's Improved..... 59
Supply, Fire Engine Pumps Public 449
Supply Improvement, Kansas City's 76
Supply, Kansas City 252
Supply, Municipal Partnership in.256
Supply, Ranger's 56
Supply, World's Longest Tunnel for New York's 465, 496
to a Concrete Mixer, Delivering Cement and 509
Works Benefit by Adversity.....525
Works Consumers, Educating...258
Works Convention, American, 526, 546
Works Intake, Boosting a.....410
Works Met Cost Increases, How.530
Works, Milwaukee 173
Pipe 549
Works Notes in Europe 51
Works Notes, New Bedford.....394
Works Properties, Appraisal of.480
Works Reports and What They Should Contain 473
Works, San Francisco Votes Against Purchasing 264
Works, To Vote on Purchase of San Francisco 174
Works, Valves, Inspecting.....242
Works Wireless 228
Welding, Oxyacetylene Torch for
Well, 50 Feet Deep, Lining a 20-Foot.507
West Virginia, Water-Borne Typhoid in 476
White, Alfred T. 170
Wider, Making Narrow Roads.....318
Winter?, What Disposition Is Best for Construction Equipment During the 82
Wireless, Water Works 228
Wisconsin State Highways.....12
Worcester, Mass., Sewage Disposal at 421
Work Done During 1920 and Contemplated During 1921—Table 398, 412, 432
Federal Aid Road 320
for the Street Force, Winter.....316
in View, No End to Road.....323
in 1920 and 1921, State.....336
on a New Jersey State Road, Heavy 443
Works Booming, Public 409
, Publicity for Public.....430
Writing for Technical Papers.....207
Zones, Changes in New York's Build-
Zones, Changes in New York's Build-
Zoning, Simplifying 35
1921, Here's to 9

LEGAL NEWS

Assessing Paving Costs, City's Power to Connect by Paving the Paved Portions of Streets—Engineering Expenses, Property Included in 438
Assessment and Contract Are Void—Where Competitive Bidders Required to Furnish Their Own Specifications for Paving....269
, Engineer Properly Empowered to See that Sewer Properly Constructed—Pumping Station for Sewage Subject for Special.363
Not Invalidated by Omitting Railroad not Benefited 84
Purposes Disposal Plant for Portion of City Sewage Held Local, Not Public Improvement for...537
Unenforceable, City's Failure to Follow Statutory Procedure Makes 385
Assessments for Improvements, Principles of 84
for Paving by the Front Foot

Rule 16
Awnings as Encroachments on Sidewalks 178
Barriers Alongside Highway, State and Towns Held Not Negligent in Failing to Erect.....537

Bid by Demand for Return of Check for Deposit, Withdrawal of Invalid, Award of Paving Contract on Incomplete.....269
Bidders Required to Furnish Their Own Specifications for Paving, Assessment and Contract Are Void—Where Competitive.....269
Bills Promptly, Discrimination to Customer by Allowing Failure to Pay 510
Board of Water Works and Light, Status of Municipal 84
Boards of Public Works, Limited Authority of Members of.....289
Bond Does Not Cover Equipment Rented and Not Used, Public Works Contractor's 154
Issue for Purchase of Utility to Voters, Submission of.....306
, Materialmen's Right of Action on Public Works Contractor's.363
Must Be Brought Within Statutory Time, Action on Public Works Contractor's 199
, Officers Personally Liable for Failure to Require Public Works Contractor's 154
, Subcontractor's Rights Under Contractor's 106
to City as to Diligence in Service of Process Thereon Must Be Observed, Provision in 306

Commissioner to Supervise Construction Prohibited by Statute, Employment of Road 269
Compensation to Injured Employees of Uninsured Contractors, Illinois Cities Must Pay 306
Competition by Municipal Lighting Plant 510
Condemnation by Municipality of Land in Another State for Water Works 178
Contract, Contractors Indispensable Parties to Suit to Restrain City from Complying with 460
Let, Effect of Change of Grade After Grading 16
on Incomplete Big Invalid, Award of Paving 269
Rendering It Unenforceable, City's Option to Terminate Construction 16
, Subcontractor's Rights Measured by Voidable 199
, Validity of Sidewalk—Alternative as to Materials..... 44
Contractor for Interest on Bank Deposit, City Held Not Liable to 84
Contractor's Bond Does Not Cover Equipment Rented and Not Used, Public Works 154
Bond, Materialmen's Right of Action on Public Works 363
Bond Must Be Brought Within Statutory Time, Action on Public Works 199
Bond, Officers Personally Liable for Failure to Require Public Works 154
Non-Performance Caused by Delay of Street Railway Company of City, No Liability for.....306
Contributory Negligence in Driving Overhead Bridge 289

Damages for Wrongfully Cutting Off Water 289
, Owner Joining in Petition for Change of Grade Stopped from Claiming 510
Day-Light Saving Ordinance, Validity and Scope of Municipal...385
Dedicated Streets, Proof of Acceptance by Municipality of.....363
Dedication and Acceptance of Street Not Proven, Implied 229
Defect in Street for Jury, Constructive Notice to City Authorities of 385
Delay of Street Railway Company or City, No Liability for Contractor's Non-Performance Caused by 306
Deposit, City Held Not Liable to Contractor for Interest on Bank.. 84
Discrimination to Customer by Allowing Failure to Pay Bills Promptly 510
Disposing Plant for Portion of City Sewage Held Local, Not Public Improvement for Assessment Purposes 537

Eight-Hour Day Law, City Firemen Not Within Public Works....199
Electric Plant Situated Without the Municipality Limits, Exemption from Taxation of Municipality's 460
Employee After Special Employment Ends for the Day, No Liability of City for Injury to Garbage Driver as Special.....306
Transferred to Special Employment, Compensation for Injury to 199
Employees of Uninsured Contractors, Illinois Cities Must Pay Compensation to Injured.....306
Encroachments on Sidewalks, Awnings as 178
Engineer Properly Empowered to See that Sewer Properly Constructed—Pumping Station for Sewage Subject for Special Assessment 363
Engineering Expenses Properly Included in Assessing Paving Costs, City's Power to Connect by Paving the Paved Portions of Streets 438
Equipment Rented and Not Used, Public Works Contractor's Bond Does Not Cover.....154
Excavation Contract Construed, Subcontractor's 229
Excess Work Distinguished from Extra Work in Road Contract....178
Execution, Municipally Owned Water Works Not Subject to.....199
Extra Work in Road Contract, Excess Work Distinguished from.178

Firemen Not Within Public Works Eight-Hour Day Law, City...199
Franchise Fixing Rates, Increase of Hydrant Rates Notwithstanding 385

Grade After Grading Contract Let, Effect of Change of..... 16
Stopped from Claiming Damages, Owner Joining in Petition for Change of 510

Highway by Fence, Injunction for Obstruction 178
of Funds, Liability of Subscribers for 106
ity of Subscribers to.....196
Hydrant Rates Notwithstanding Franchise Fixing Rates, Increase of 385
, Water Company Held Liable to Party Injured Under Indiana Statute for Injury by Defective Fire 537

Ice in Streets—Proper Care Required of Pedestrians 438
Icy Sidewalks, Injuries by Defective Spouts Causing—Indemnity Recoverable by City from Property Owner 229
Improve Streets Held Sufficient, Though Irregular, Resolution of Intention to 269
Improvements, Principles of Assessments for 84
Injunction Against Municipality Dismissed, Water Pollution—Petition for 178
of Sale of Property for Sidewalk Tax Refused 44
Injuries by Defective Spouts Causing Icy Sidewalks—Indemnity Recoverable by City from Property Owner 229
Injury on Street—Proximate Cause—Notice of Defective Condition.154
to Employee Transferred to Special Employment, Compensation for 199

Land for Water Works Beyond Five-Mile Limit Invalid Under City Charter, Purchase of 154
Liability of City for Injury to Garbage Driver as Special Employee After Special Employment Ends for the Day, No.....305
Liable to Party Injured Under Indiana Statute for Injury by Defective Fire Hydrant, Water Company Held 537
Liable to Traveler Assuming Risk in Fog, City Not 154
Lighting Plant, Competition by Municipal 510
Limits Powers of Municipalities to Construct Improvements Beyond 44
"Local Improvement," What Is Covered by the Term 385

Materialmen's Right of Action on Public Works Contractor's Bond 363
Materials, Alternative as to Validity of Sidewalk Contract 44
Negligent in Failing to Erect Barriers Alongside Highway, State and Towns Held Not.....537
News Stands as Obstructions in City Streets 106
Notice of Defective Condition, Injury on Street—Proximate Cause...154
to City Authorities of Defect in Street for Injury, Constructive..385
Nuisance by Sewer Held Too Remote to Invalidate Tax Bills, Possible 229

Obstruction of Highway by Fence, Injunction for 178
Officers Elected Under Unconstitutional Charter Provisions Are DeFacto Officers 84
One-Way Street Ordinance for Automobiles Held Valid 154
Overflow of Land Not Approximately Caused by It, City Not Liable for 229
Paving Between Tracks—Compelling Removal of Car Tracks to Center of Street 84
by the Front Foot Rule, Assessments for 16
of Railroad Crossing by Railroads 537
the Paved Portions of Streets, City's Power to Connect by—Engineering Expenses Properly Included in Assessing Paving Costs 438
, What Constitutes an Original.. 16
Pollution—Petition for Injunction Against Municipality Dismissed, Water 178
Power, Order to Director of Public Works to Lay Out Proper Sewer Held Not Unlawful Delegation of 438
Property, Municipality's Power to Sell Disused 106
Public Works, Limited Authority of Members of Board of 289
Pumping Plant, Authority to Maintain Water Works Includes Power to Substitute Electric for Steam 363
Station for Sewage Subject for Special Assessment—Engineer Properly Empowered to See That Sewer Properly Constructed 363
Railroad Crossing, Washington Commission Cannot Deny City's Application for 438
Crossings by a City Within Its Limits, Regulation of.....460
Exclusive Use of a Substantial Part of a Street, Municipality Cannot Give 306
Not Benefitted, Assessment Not Invalidated by Omitting..... 84
Railroad Crossing by Railroads, Paving of 537
Rates Fixed by Ordinance Should Yield Reasonable Return on Investment, Water 510
, Increase of Hydrant Rates Notwithstanding Franchise Fixing.385
Regulation of Municipally Owned Public Utilities 460
Resolution of Intention to Improve Streets Held Sufficient, though Irregular 269
of Intention to Improve Streets Must Be Properly Passed ...229
Return on Investment, Rates Fixed by Ordinance Should Yield Reasonable 510
Road Commissioner to Supervise Construction Prohibited by Statute Employment of 269
Sewage Held Local, Not Public Improvement for Assessment Purposes, Disposal Plant for Portion of City 537
Sewage, Subject for Special Assessment, Engineer Properly Empowered to See that Sewer Properly Constructed—Pumping Station for 363
Sewer Held Not Unlawful Delegation of Power, Order to Director of Public Works to Lay Out Proper 438
Held Too Remote to Invalidate Tax Bills, Possible Nuisance by.229
Material Held Inadmissible as Improperly Based, Expert Testimony as to the Unfitness of.. 44
Sidewalks, Accumulation of Snow and Ice on 199
Snow and Ice on Sidewalks, Accumulation of 199
Specifications for Assessment and Contract Are Void Where Competitive Bidders Required to Furnish Their Own.....269
Street, Compelling Removal of Car Tracks to Center of—Paving Between Track 84
, Municipality Cannot Give Railroad Exclusive Use of Substantial Part of a 306

Not Proven, Implied Dedication and Acceptance of 229
Streets, Ice in—Proper Care Required of Pedestrians Must Be Properly Passed, Resolution of Intention to Improve 229
, News Stands as Obstructions in City 106
, Proof of Acceptance by Municipality of Dedicated 363
Resulting in Private Benefit, Vacation of 16
Subcontractor's Excavation Contract Construed 229
Rights Measured by Voidable Contract 199
Rights Under Contractor's Bond.106
Subscribers to Highway Funds, Liability of 106
Tax Refused, Injunction of Sale of Property for Sidewalk 44
Taxation of Municipality's Electric Plant Situated Without the Municipality Limits, Exemption from 460
Tenants in Building, Regulating Supply of Water to 510
Testimony as to the Unfitness of Sewer Material Held Inadmissible as Improperly Based 44
Tracks to Center of Street, Compelling Removal of Car—Paving Between Tracks 84
Traffic, Distinction Between Urban and Interurban Passenger Car.269

Unconstitutional Charter Provisions Are DeFacto Officers, Officers Elected Under 84
Urban and Interurban Passenger Car Traffic, Distinction Between...269
Utilities, Regulation of Municipally Owned Public 460

Vacation of Streets Resulting in Private Benefit 16
Voters, Submission of Bond Issue for Purchase of Utility to 306
Water Company Held Liable to Party Injured Under Indiana Statute for Injury by Defective Fire Hydrant 537
Water, Damages for Wrongfully Cutting Off 289
Does Not Impliedly Warrant Its Wholesomeness, City Owning Waterworks and Furnishing..289
Mains, Extension of 460
Pollution—Petition for Injunction Against Municipality Dismissed 178
Rates Fixed by Ordinance Should Yield Reasonable Return on Investment 510
to Tenants in Building, Regulating Supply of 510
Works, Condemnation by Municipality of Land in Another State for 178
Works Includes Power to Substitute Electric for Steam Pumping Plant, Authority to Maintain..363
Works Not Subject to Execution, Municipally Owned 199

SOCIETIES

Architectural and Engineering Societies, Minnesota Federation of.310
Asphalt Association 400
Awards, National Board of Jurisdictional 290

Building and Construction Industry, The National Congress of...86, 180
Officials Conference 230

City Planning, National Conference on 489
Civic Federation, The National 85
Commerce of the United States, Chamber of 290
Construction Industries, National Federation of 214, 246
Industry, The National Congress of Building and 86, 180
Concrete Institute, American..118, 139, 213
Contractors, Associated Pennsylvania Highway 418
Association, Associated General.. 86
, Association of General 180
of American, Associated General.179
of Massachusetts Highway....179
to Join Associated General Contractors Dena 85

Drainage Association, Wisconsin State 270
Congress, Utah Irrigation and...215

Education, Conference on Employment and 18
Employment and Education, Conference on 18
Engineering Board, Minnesota Joint. 46
Council, American....138, 209, 279, 364, 386
Council Petitions President Harding 246
Dinner to Hoover 149
Institute of Canada 215
Institute of Canada, Cape Breton Branch 179
Societies, The Federated American 338
Societies, Federated American—Executive Board 46
Societies, Minnesota Federation of Architectural and 310
Societies of St. Louis, Associated.108
Society, American Railway 310
Society, Arkansas 150
Society, Detroit 511, 489
Society, Indiana 68
Society, Iowa 88, 156, 209
Society, Iowa—Annual Meeting... 46
Society, Iowa—Holds Successful Meeting 108
Society, Jamestown 200
Society, Kansas 108
Society, Louisiana ..17, 215, 387, 558
Society, Providence 209
Society, Rochester 511, 489
Society, United 200
Society of Wisconsin 279
Society, Wyoming 246
Engineers, Albany Society of Civil..108
, American Association of..17, 45, 108, 214, 230, 290, 310, 338, 364, 440, 461, 538
, American Association of—Idaho Chapter 215
, American Association of—Indianapolis Chapter 310, 215
, American Association of—New York State Assembly 387
, American Association of—Twin City Chapter 433
, American Institute of Electrical.489
, American Society of Civil..107, 290, 364, 400, 461, 511
, American Society of Civil—Buffalo, N. Y. Section....440
, American Society of Civil—Illinois Section 107
, American Society of Civil—Kansas Section 387
, American Society of Civil—Large Vote for Officers....139
, American Society of Civil—New York Section 270, 462, 489
, American Society of Civil—San Francisco Section 107, 310
, American Society of Civil—Seattle Section 246
, American Society of Mechanical ..85, 139, 387, 418, 400, 511
, American Society of Mechanical —Coming Meetings 46
, American Society of Mechanical —Hartford Section 246
, American Society of Mechanical —Philadelphia Section 107
, American Society of Safety.462, 489
, Automative 107
, Boston Society of Civil, Address to 17
, British Institution of Civil, to Increase Dues and Avoid Deficit 17
Engineers' Club of Baltimore....180
Club, Brooklyn, 86, 179, 270, 310, 400, 439, 511
Club of Des Moines....68
Club, Kentucky 108
Club, Memphis 139
Club of Philadelphia, 86, 108, 310, 511
Club of San Francisco....68
Club, St. Paul 156
Club, Topeka 215
Club, Webster City 178
Engineers, Colorado Society of....200
, Conference of State Sanitary, 461, 538
, Connecticut Society of Civil...179
, Illinois Society of 215
, Manitoba, to Enforce Salary Schedule 18
, Mechanical 156
, Montana Society of 440
, New Jersey County 68
, North Dakota Society of....290
of Alberta, Professional 387
Society, Minnesota Surveyors and 270
, Society of American Military—The Philadelphia Post....17
Society of Pennsylvania 511
, Utah Society of 108
, Vermont Society of 387
, Western Society of....68, 462

Highway and Transport Education Conference, Mid-Western 156
Association, Massachusetts 387
Contractors, Associated Pennsylvania 418
Contractors' Association, Kentucky— 139
Council, Federal 364
Officials American Association of State 46
Traffic Association, National. . 418
Traffic Regulations, National Conference on 198
Transportation Show 88
Housing in America, Eighth National Conference on 17

Irrigation and Drainage Congress, Utah 215

Municipal League, California....197

Pine Association, Southern....387
Purdue University, Seventh Annual Road School 156

Railway Engineering Society, American 310
Research Federation, Personnel....270
Road Builders Association, American.200
Builders' Association New York State 387
Builders' Association, Texas....180
Building Contractors' Association, West Virginia 198
Officials, Conference of Iowa....387
School of Purdue University, Seventh Annual 156
Roads Association, New Hampshire Good 387
Association, Virginia Good....156
Congress and Show, The Eleventh Annual American Good....138
Convention 440
Convention, Canadian Good 489

Sanitary and Water Supply Association, Indiana 310
Sewage Works Association, New Jersey 215
Standardization Council on 489
Surveyors' and Engineers' Society, Minnesota 270

Traffic Association, National Highway 364, 418, 439
Transport Education Conference, Mid-Western Highway and 156
Water Supp.y Association, Indiana Sanitary and 310
Water Works Association, American 418, 439
Works Association, American—Illinois and Iowa Sections....387
Works Association, American—New York Section 214
Works Association, New England 45, 68, 139, 200, 538
Works Association, New York Section 290
Works Association, Southwest, 246, 461

NEW APPLIANCES

Ajax—On Highway Construction, Hercules 402
Anthony Dumping Equipment....490
Arcadia Trailers for Motor Trucks..463
Asphalt Block Press 69
"Asphalt Macadam" Roads, How to Build 233
Asphaltum Products, Conway 272
Austin Meter Pump 181
Model 6 Excavator 109
Motor Sweeper 401
Trenching Machine, A New All-Multipedal 87
Austin-Western Road Machinery....231
Auto-Sweeper, The 311
Barber-Green Loaders on Pavement Work 420
Snow Loader 109, 491
Bars, Universal 248
Bitoslag Pavement 248
Blaw Forms 490
Block Press, Asphalt 69
Bodies, All-Steel Dump 157
and Hoists, Quality Tanks....388
for Garbage Collection, Steel....464
, Motor Truck 442
, Truck Hoists and 512
Brown Port-A-Belt, The 490
Bubble-Font, Murdock Anti-Freezing.340
Builder, Oswald Road 539
Bulletin, Pump Governor 311
Bunk, The Fort Pitt Sectional....181

Car, A New Trailer Dining and Cook.110
Cars and Wheels, Giant Mine....272
, Conkey 442
, Four-Wheel Drive Motor....87
Case Road Building Equipment....20
Castings, Municipal 248
Cleveland Air Tools 69
Compressor, Imperial Portable 47
Compressors, Sullivan Air 513
Compressor, Sullivan Portable Mine Car Air 560
Conkey Cars 442
Construction, Hercules Ajax-On Highway 402
Controller, Maximum Demand Water.442
Cox Operating Valve Illustrated....87
Crane, A New Crawling Tread....339
205, P & H Excavator 513
Cranes, Browing Locomotive....388
, Crawling Tread Locomotive....512

, Overland 339
Crusher, Gruendler Stone 311
Curb, Economy Reversible Manhole..232
Cutting Machines, Pipe 339

Dake Engines 441
Dining and Cook Car, A New Trailer.110
Drag, B. B. Reversible Road.....339
Dump Bodies, All-Steel 157
Body, Gammon 291
, One-Ton Truck 158
Dumping Equipment, Anthony.....490
Equipment, Heil 349

Earthcrete 248
Easton Industrial Railways 69, 419
Engineers' Supplies, Civil 247
Engines, Dake 441
Engines for Emergency Pumping, Sterling 540
Equipment, Case Road Building..... 20
, Highway Construction 401
, Koppel Industrial Track and...512
Excavator, Austin Model 6.....109
, Ladder Type Standard.....492
Excavators, Jack of All.....388
Excavator, Wheel Type of P & H....540
Evinrude Unit Centrifugal Pumps...539

Fairfield Car Unloader.....540
Federal Road Building Truck.....292
Feed Machines, Dry Chemical.....231
Fire Department Truck, New.....181
Signals, Worcester 19
Forms, Blaw 490
, Steel Road 271
Fort Pitt Sectional Bunk, The.....181
Four-Wheel Drive Motor Cars..... 87

Garbage Collection, Steel Bodies for..464
Governor Bulletin, Pump.....311
Grading, Duplex Highway 491
Grading, Strenuous Machine 560
Gruendler, Stone Crusher.....311
Guards, Paving 231

Hammers, McKiernan-Terry Steam..201
Hauck Concrete Heaters 47
Heaters, Hauck Concrete 47
Hercules Ajax—On Highway Construction 402
Highway Construction Equipment...401
Construction, Hercules Ajax—On.402
Hoist, Van Dorn Dump Truck Body..291
Hoists and Bodies, Truck 512
, Quality Tanks, Bodies and.....388
Holt Caterpillar Tractors 271
Hug Truck Turntable 271

Incinerator Co., Chicago.....272
Interlock 513

Jack, Automatic Lowering.....491
Joints, Servicised 442

Koppel Industrial Track and Equipment 512

Lackawanna Sheet Piles 491
Lamps, Westinghouse Street 201
Light, Mushroom Traffic.....271
Loader, Barber-Green Snow....109, 491
for Concrete Highway Work, Stamp Mixer 201
Loaders on Pavement Work, Barber-Green 420
, Specialty 463
Loading, Mechanical Snow 442
Locomotive, American Gasoline.....402

Machine, A New All-Multipedal Austin Trenching 87
, Spalding 2-in-1 Road 109
Machinery, Austin-Western Road....231
, Champion 402
, Excavating and Earth Handling.291
, Stroud Road Making.....401
Machines, Dry Chemical Feed.....231
, Pipe 157
, Pipe Cutting 339
Manhole Curb, Economy Reversible..232
McKiernan-Terry Steam Hammers...201
Mead-Morrison Truck Winches..... 18
Meter 366
Mixers, Giant Concrete 248
Mixer, Smith Non-Tilting 560
Morand Truck Wheels.....442
Motor Cars, Four-Wheel Drive..... 87

Nelson Four-Wheel Drive Tractor....311
Novo Beach Saw Rig.....419

Oswald Road Builder 539

Paints, Solvay 48
Pavement, Bitoslag 248
Pavements at Half the Cost, New....366
Paving Guards 231
Piles, Lackawanna Sheet.....491
Planer, Jones Patent, Kinney Road..157
Port-A-Belt, The Brown 499
Press, Asphalt Block 69
Pump, Austin Meter 181
, Jumbo Trench 513
Pumping Machinery, High Efficiency 19
Outfit, Novo High Pressure.....366
Pumping, Sterling Engines for Emergency 540
Pumps, Evinrude Unit Centrifugal..539
Pumps, Self-Oiling Bulldozer Power.312
, Sullivan 512

Railways, Easton Industrial.....69, 419
Returner, Ash Barrel 272
Road Builder, Oswald.....539
Road Building Equipment, Case..... 20
Construction and Maintenance with White Trucks.....109
Machine, Spalding 2-in-1.....109
Machinery, Austin-Western 231
Maintainer 559
Maker, Martin Perfect 419
Making Machinery, Stroud 401
Road-Razer 514
Road Tools 420
Roads, How to Build "Asphalt Macadam" 232
Roadway, Tarvia Macadam 340
Robinson & Co., Inc. 272
Rogers All Steel Trailers.....463
Rollers, Monarch 271
Root Spring Scrapers 491

Sanitation of Cities, The.....232
Santest 181
Saw Rig, Novo Beach 419
Scrapers, Root Spring 491
Screens, Whip-Tap Sand and Gravel..388
Semi-Trailmobiles, Trailmobiles and..442
Service Box, M. B. 340
Servicised Joints 442
Sharpener, Sullivan Drill 539
Smith Non-Tilting Mixer 560
Snow Loader Barber-Green 109, 491
Loading, Mechanical 442
Solvay Paints 48
Spalding 2-in-1 Road Machine.....109
Stamp Mixer Loader for Concrete Highway Work 201
Stroud Road Making Machinery.....401
Sullivan Air Compressors 513
Pumps 512
Sullivan Drill Sharpener 539
Portable Mine Car Air Compressors 560
Supplies, Civil Engineers' 247
Sweeper, Austin Motor 401

Tanks, Bodies and Hoists, Quality..388
Tar Products, Coal 272
Tools, Cleveland Air 69
, Road 420
Track and Equipment, Koppel Industrial 512
Layer Tractor Best 110
Tractor, Best Track Layer 110
, Nelson Four-Wheel Drive 311
, Powerox Industrial 271
Tractors, Holt Caterpillar 271
Trailers for Motor Trucks, Arcadia..463
, Rogers All Steel 463
, Warren Heavy Duty Truck....247
Trailmobiles and Semi-Trailmobiles..442
Trenching Machine, A New All-Multipedal Austin 87
Truck Bodies, Motor 442
Dump, One-Ton 158
, Federal Road Building.....292
, New Fire Department.....181
Trucks, Arcadia Trailers for Motor..463
, Road Construction and Maintenance with White 109
, Tec 463
Turntable, Hug Truck 271

Union Fitts Chronometer Valve..... 87
Unloader, Fairfield Car 540

Utilitor Road Maintainer 559

Valve Illustrated, Cox Operating..... 87
, Union Fitts Chronometer..... 87
Van Dorn Dump Truck Body Hoist...291

Warren Heavy Duty Truck Trailers.247
Water Controller, Maximum Demand.442
Waterproofing, Impervite 157
Waughoists 492
Westinghouse Street Lamps.....201
Wheels, Morand Truck 442
White Trucks, Road Construction and Maintenance with.....109
Winches, Mead-Morrison Truck 18
Worcester Fire Signals 19

AUTHORS

Bassett, Edward M.
"Changes in New York's Building Zones" 92
Brainard, John T.
"Break in Lancaster's Water Main" 143
Brown, Charles Carroll
"The Illinois Experimental Highway" 115, 166

Child, John T.
"Some Observations and Facts Concerning Motor Sweepers"..159

Drandell, John S.
"Making Narrow Roads Wider"..318
Downes, John R.
"Operating Date of Fine Screen and Imhoff Tanks" 379

Ford, George B. and Goodrich, E. P.
"Simplifying Zoning" 35

Gilkison, George F.
"Use of Copper Sulphate in Kansas City Reservoir" 260
Goodrich, E. P. and Ford, George B.
"Simplifying Zoning" 35

Hardenbergh, W. A.
"Sand Filters for Small Sewage Plants" 275
"Street Paving in Goldsboro"....115
"Substitution for Sewers"...293, 358
Harrington, John Lyle
"A Workable Form of Contract".361
Hill, W. B., Jr.
"Grading Road with Tractors and Wheel Scrapers" 406
Hubbard, Prevost
"Non-Rigid Bases for Pavements"111
Howell, William A.
"Repairing a Wood Block Pavement in Newark, N. J."....515

Kane, Walter W.
"Computing Parabolic Curves for Street Grades" 373

Livingston, C. R.
"Bituminous Filled Brick Pavements with Lugless Brick"....293

Macallum, A. F.
"Modern Cast Iron Pipe"..... 75
MacDonald, Thomas H.
"Federal Aid Road Work".....320
McCrory, S. H.
"The Effect of Alkali upon Concrete" 399
McDonnell, R. D.
They Should Contain" 473
They Should Contatin".....473
McEwen, T. C.
"Road Drainage Structures in Giles County" 345

Pollock, Clarence D.
"Improved Heavy Traffic Pavements in Jersey City".....423

Simpson, John
"Liability of Municipality for Nuisance in Garbage Disposal".354

Tay, S. W.
"Outfit for Measuring the Level of Liquids" 478

Wise, Colin R.
"Refuse Disposal in Passaic"....367
Wise, Colin R.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

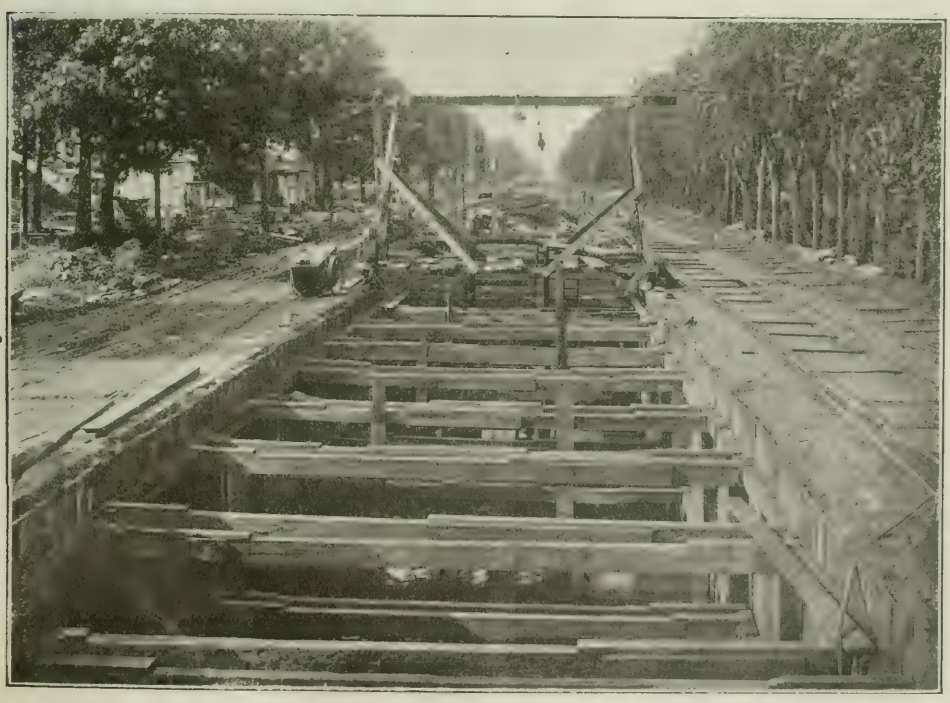
Entered as Second Class matter at the Post Office at Floral Park, N. Y., August 27, 1909, under the Act of March 3, 1879

Vol. 50 FLORAL PARK, JANUARY 1, 1921 No. 1

Ocean Avenue Storm Sewer

5,000 feet of single and double 126-inch to 138-inch sewer built in wet sand in sheeted trench requiring heavy pumping with movable suspended pumps. 16,000 yards of concrete delivered in carts from central mixing plant.

The storm-water sewer in Ocean avenue, Brooklyn, is the drainage outlet for a large, flat area, the run-off from which will be delivered to Sheepshead bay through about 5,000 feet of this sewer, which terminates in an outlet on the shore of Sheepshead bay at Emmons avenue. The sewer was designed by, and was built under the direction of, the Bureau of Sewers, Borough of Brooklyn, Arthur J. Griffin, chief engineer. The portion here described is on a tangent about 5,000 feet long on the center line of Ocean avenue, with a grade of 0.08 per cent and a depth from the surface of the ground to the bottom of the invert concrete varying from about 16 feet at the



WIDE, DEEP TRENCH DRAINED BY ELECTRICALLY DRIVEN CENTRIFUGAL PUMPS SUSPENDED FROM GANTRY TRAVELER

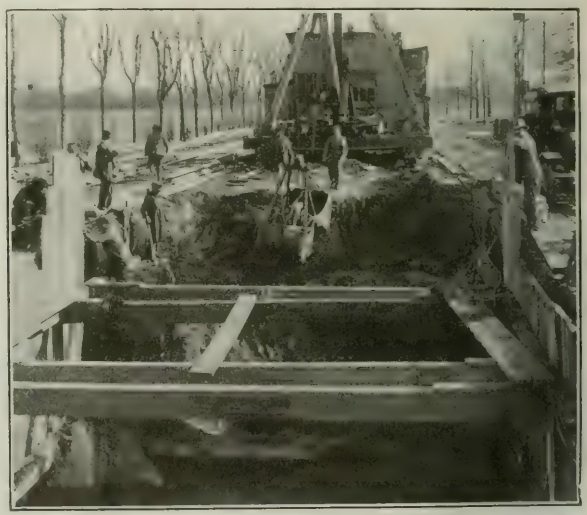
SHALLOW FLUME TO DISCHARGE WATER PUMPED FROM SUMPS IN TRENCH

upper end to 12 feet at the lower end, where the surface of the ground is 6 feet above datum or mean high tide.

The contract for the sewer was awarded in April, 1918, to the Newman & Carey Company, for about $328,421.57, based on the unit prices for the estimated quantities, which included 62,200 yards of excavation, 16,000 yards of concrete and 5,000 feet of trench sheeting and bracing. The location is in sandy soil which, up to about mean high tide level, is saturated with water flowing freely into the excavation and thus producing a maximum head of about 8 feet above the lowest part of the trench; notwithstanding which, the work has progressed to a present nearly completed stage with no serious trouble from the large volume of water encountered and satisfastorily disposed of.

For a distance of 2,500 feet from the outlet the 138-inch sewer is of the twin type with flat roof, vertical side walls and V-shape invert, corresponding exactly to the 168-inch twin storm-water sewer in Ralph avenue, Brooklyn, illustrated on page 528 of Public Works, December 4, except for the somewhat reduced dimensions, which are 21 feet 1 inch wide and 10 feet 7 inches high over all, with two conduits 8 feet 7 inches wide and 8 feet high at the center. From Avenue Y about 1,600 feet to Avenue W the 132-inch sewer is 19 feet 3 inches wide and 10 feet 5 inches high over all, with two 7-foot 10-inch x 8-foot conduits separated by a 15-inch vertical center wall. The 126-inch sewer about 900 feet long from Avenue W to Avenue Z, where it will join a previously constructed section of 120-inch sewer, is 16 feet 10 inches wide and 10 feet 7 inches high over all, and has a single conduit similar to the conduit in the twin sewer and having a width of 13 feet 10 inches and height of 7 feet 6 inches with a reinforced flat concrete roof 19 inches thick, reinforced V-shape invert 1 foot 6 inches in minimum thickness, and vertical side walls 18 inches thick without reinforcement.

At the outlet, just beyond the shore line, the 138-inch twin sewer is supported on six short, longitudinal rows of wooden piles with a platform of 4-inch longitudinal planks laid on the 10 x 10-inch transverse pile caps. The shore end of the sewer is faced with cut-stone blocks 1 foot 6 inches thick, and the thickness of the side walls is increased to 2 feet 8 inches for a length of about 41 feet, where it joins with a section of the regular 138-inch sewer with a shoulder that takes bearing against the face of a continuous line of 10 x 10-inch splined yellow pine sheet piles that encloses both sides and the outer end of the sewer and is anchored to it with 1½-inch horizontal bolts embedded in the wall concrete and engaging rangers against the outer faces of the sheet piles at top and bottom of the sewer. At the open end of sewer the sheet piles are cut off a few inches below the upper surface of the invert and the transverse ranger at that elevation is anchored to the invert concrete with 1½-inch horizontal bolts through the invert concrete, and to three slightly inclined fender piles extending to the top of the sewer, where they are similarly anchored with a clearance of about 6 inches.



STARTING SHEET PILE DRIVING AND BRACING SIMULTANEOUS WITH EXCAVATION

TRENCH EXCAVATING AND SHEETING

The sewer was built in open trench about 3 feet wider than the over-all width of the sewer, and having a depth of from 8 to 16 feet below the surface of the ground. The double-track trolley line on Ocean avenue was operated during the construction of the sewer and in the summer months carried large numbers of passengers to

and from the shore. As both sewer and trolley lines are located concentric with the street, the trolley lines were shifted to one side of the broad street before the excavation was commenced. The stone pavement between the rails was first taken up and piled along the curb simultaneously with or subsequent to which the rails, spliced and connected by transverse bars, were jacked up in long continuous sections to an elevation above the surface of the pavement and shifted sideways to the new position.

On each side of the main trench there was carefully excavated with pick and shovel a narrow trench about 2 feet deep with the outer face vertical and carefully aligned in the plane of the face of the main trench. In these trenches groups of 2 x 10-inch square edge planks 16 feet long, with their lower ends adzed to a knife edge, were assembled against the vertical sides of the trenches and were held in position by rangers in the bottoms of the trenches, braced securely against them. Scaffold planks laid on high trestles on the outer side of the trenches formed platforms for men driving the sheeting successively, a few inches at a time with a McKiernan-Terry air hammer simultaneously with the excavation of the main trench, taking care to loosen the ground around the bottoms of the piles and remove any obstructions encountered. The driving was facilitated by the use of a ½-inch hydraulic jet supplied with water from the city main at a pressure of about 60 pounds.

The excavation of the main trench was done with a 1-yard clamshell bucket operated by the 50-foot boom of a stiff-leg derrick equipped with a bull wheel and a Lidgerwood hoisting engine, and installed on a 4-wheel wooden platform traveling on a track of about 18 feet gauge laid in the center of the street in advance of the excavation. The bucket delivered directly to automobile trucks alongside, which carried the material to the other end of the trench and dumped it for backfill over the completed part of the sewer, and hauled surplus material to the spoil banks. As the excavation progressed, a second tier of rangers and braces was installed 5 or 6 feet below the upper tier, and the sheet piles were driven down to the full length penetration, the bottoms being from 1 to 3 feet below the bottom of the trench.

No extra care was taken to drive the sheet piles in close contact and the ground water flowed freely through the cracks between adjacent piles and was collected in shallow, narrow trenches on each side of the excavation, through which it flowed to sumps excavated 2 or 3 feet below the bottom of the trench and drained by one 8-inch and one 10-inch Lawrence centrifugal pumps operated by electricity and suspended from a 4-wheel gantry spanning the trench and traveling on a track of about 25 feet gauge. As the excavation advanced with the progress of the work, new sumps were dug about 80 feet apart, the old sumps being filled and covered by the invert. The pumps were hoisted above the surface of the ground by tackles operated by a hand windlass or crab installed on the gantry and the gantry moved forward to the next sump, where the pumps were lowered to position and the operations continued. The pumps worked day and night, keeping the trench free of water that otherwise would have been very troublesome and en-

FINISHED TWIN SEWER WITH DRAINAGE CHANNEL EACH SIDE. EXCAVATING DERRICK AND PUMP GANTRY IN BACKGROUND

abling the bottom to dry out and become stable and firm enough to support the sewer without foundation piles.

The pump delivered to short, vertical risers and long lengths of horizontal screwed pipe. Where the screwed pipe was not long enough to reach to a point where the water could be discharged to surface drains or existing sewers, they discharged into broad shallow wooden flumes, built for the purpose, and in some cases carried over the top of the finished sewer and extending to a maximum length of about 2,000 feet.

CONCRETING

The inverts for the full width of the two twin conduits were concreted on the carefully leveled sub-grade in sections 40 feet long, made in side forms spaced about 18 inches from the sheeting to give room for the exterior drainage channels. The inclined upper surface of the invert between the center and side walls was concreted against wooden lagging bearing against the under side of transverse ribs made like scarfboards, to conform to the outline of the invert and fastened securely at the proper elevation to the lower tier of struts bracing the sheeting. After the lagging had been stripped and the ribs removed, the surface of the invert was paved, in some cases with special curved tile, and in others with selected bricks.

After the invert had been paved, the vertical sidewalls and flat roof were built in corresponding 40-foot sections at continuous operations, usually requiring about 12 men for 8 hours. Transverse bents having horizontal bottom sills with their ends rounded to fit exactly against the curved portion of the invert were braced together forming supports for four lines of longitudinal timbers on which were wedged up sectional wooden ribs about 2 feet apart, covered with wooden lagging 10 feet long, and making three separate panels that were easily handled and were wedged up to exact position on the longitudinal pieces.

Lagging was also nailed to the outer faces of the vertical posts in the transverse bents, and vertical boards nailed to horizontal strips attached to the sheet pile rangers made the forms for the outer surface of the side walls. Transverse vertical wooden bulkheads were provided with vertical core boxes in the ends of the forms in which the concrete was deposited after the roof reinforcing bars had been put in position on concrete spacing blocks and securely wired at intersections.

After the concrete was 48 hours old the outside vertical forms were stripped, the adjustment wedges under the roof slabs and under the vertical posts of the transverse bents were slacked, allowing the lagging for the roof slabs to be dropped and then the vertical sides to be moved toward the center of the conduit, thus stripping the concrete and enabling the inside forms to be dragged 40 feet on the finished invert ready for concreting the next section. Backfilling, excavating, and sheeting all progress at the same rate as the concreting which governs the work and provided for an average construction of about 100 linear feet of finished sewer per week.

CONCRETE PLANT

An excellent quality of sand secured direct from the sewer trench excavation and broken stone delivered by barges were hauled in automobile trucks to the central concrete mixing plant established at a point about midway between the ends of the sewer section under contract and there stored in heaps on the surface of the ground, from which it was piled up and trimmed by a clam-shell bucket operated by a stiff-leg derrick with 50-foot boom that also served elevated storage bins of 20 yards and 10 yards capacity for stone and sand, respectively.

The hopper bottoms in the storage bins were closed by counterweighted flaps that, when unlatched by the attendant, delivered aggregate to the charging hopper below in which it was measured. Cement bags from the adjacent storage house were hoisted to the mixer platform by a barrel elevator operated by electricity, and the required amount of cement was added to each batch and charged into the Ransome 2-yard machine about 10 feet clear of the ground. Two-wheel carts with hopper-shaped steel tilting bodies were drawn under the mixer, two or three shovels of sand were thrown into them to prevent sticking, the carts were filled with concrete and drawn to the required position alongside the trench where they were dumped into double-gate wooden hoppers over the trench, from which the concrete was spouted to the invert and to the wall and roof forms. The average output was from 80 to 100 cubic yards per day.

Water Power in San Joaquin Valley

The cities and towns of San Joaquin valley, California, are contemplating combining in a movement to secure power sites in the mountains for the development of hydro-electric energy for municipal use, some advancement toward this having been made at the meeting last month of the San Joaquin Valley Municipalities branch of the California Municipal League.

Atlantic City's High-Pressure Fire System

A brief description of the high-pressure fire system serving the beach front of Atlantic City, N. J., was given by the engineer and superintendent of the Atlantic City Waterworks, Lincoln Van Gilder, before the New England Waterworks Association. Some of the more interesting points in this description are given below.

The system is really one for mutual protection, the power for which is furnished by the hotels along the boardwalk. A. T. Bell, manager of the Hotel Chalfonte, in 1916 conceived the idea of combining the pumping energy of the fire pumps maintained by the beach-front hotels into one general system, the mains and hydrants to be installed and maintained by the city. This proposition was endorsed by the Chamber of Commerce, the Hotel Men's Association and the leading prop-

erty holders, and was accepted by the city commission.

Pressure for the system is furnished by the underwriters' fire pumps of eight of the largest hotels, seven of them located on the beach front. These pumps all take water from the adjacent mains of the city distribution system and deliver direct into high-pressure mains. The maximum pumping capacity is about 11,000 gallons per minute at 150-pound pressure at the pumps, and the pumps are so widely distributed that there is very little friction loss. At the latest semi-official test a satisfactory pressure was maintained on 22 lines of hose discharging about 8,000 gallons per minute.

The system is planned for a maximum working pressure of 300 pounds. Lead joints with the New York type of joint were selected and class G pipes. All line joints are poured with pure lead, but joints in hydrant branches were made with an alloy of 95 per cent lead and 5 per cent tin. These alloy joints when tested at 400 pounds withou bracing the hydrant or back-filling show no trace of yielding; but one 8-inch hydrant branch which was poured with pure lead by mistake yielded perceptibly under 400 pounds pressure, and this joint was immediately taken out and repoured with alloy.

Because the soil along the beach front is almost entirely sand and because the hydrant valves had to be set at or below mean low tide in the ocean, special precautions were taken to protect valves and valve gears against corrosion due to salt and the sifting in of fine sand. All valves and hydrants were trimmed and bolted with bronze, valve stems were made of manganese bronze and gears were covered with watertight oil cases. All working parts of hydrants were built of bronze or other non-corrosive materials.

Since it was desirable to operate the hydrants from the boardwalk while the beach was several feet lower, the hydrants were made with a long barrel, the maximum length being 17 feet 9 inches from center of branch to center of nozzle.

A Concrete Job Mechanical*

Combination of mixing, hoisting and spouting units designed especially to meet the conditions of this job. Counterweighted auxiliary chutes used.

CONCRETING SYSTEM

Since the concrete footings included in the Rodgers & Hagerty contract occupy more than one-half of the area of the excavation and were to be constructed simultaneously with the completion of the excavation of the footing trenches, and since the concrete is placed in the form of several complete rings with comparatively narrow annular spaces between them, a system of distribution of concrete on the surface of the pit or by means of

Continued from page 500.

INSTALLATION OF CONCRETE DISTRIBUTING PLANT. AGGREGATE STORAGE, MIXING PLANT AND TRUCK RAMP AT THE LEFT. SLIDE FOR REINFORCEMENT BARS AT THE RIGHT.

cableways or derricks would have involved the use of transporting apparatus that would greatly interfere with construction operations, the form work and the finished and unfinished portions of the concrete. It was also evident that there was no room for a mixing plant concentric with the work nor opportunity of access to and from it had it been installed there. Consequently an isolated mixer plant and a special system of conveying and distribution was necessary that would not interfere with the operations that practically covered all of the excavated pit.

The problem was studied by the engineering department of R. E. Brooks Company, 50 Church street, New York, which worked out a satisfactory solution and design for the conveying and distribution plant eventually installed by the contractor, with the assistance of plant engineers, F. I. Ginsberg, E. Gwynn and Robinson, in co-operation with F. W. Allen, chief engineer for the contractors. This system is very simple and efficient and will, it is estimated, save a considerable percentage of the cost that would have been involved by the adoption of any of the other methods under consideration at the time the contract was awarded.

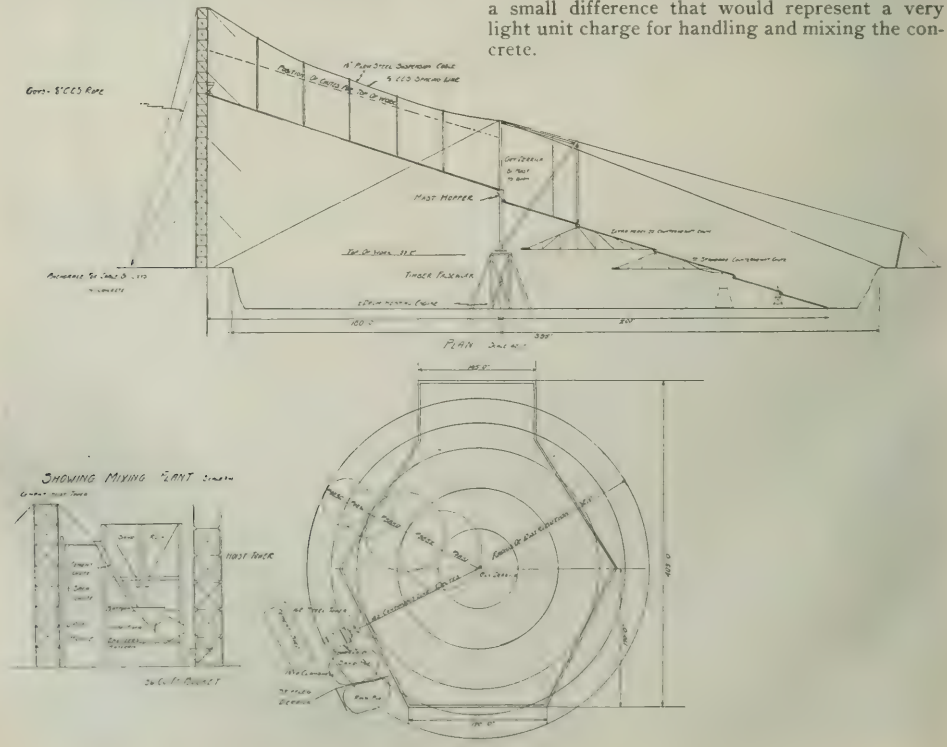
It harmonizes well with the policy of excavation which executed all of that work with improved appliances and power machinery, practically eliminating hand labor. It secures a better quality of work, more rapid execution, eliminates liability of delay from labor troubles and affords very considerable advantages by the use of the most efficient plant and capable workmen.

The essential features were the selection, combination and installation of standard high-class plant, the value of which has been abundantly demonstrated in previous successful operations, and which were so combined and arranged as to give the required service with rapidity, economy and reliability without involving any experimental features, elaborate arrangement or unusual operations requiring especially skilled attention.

The plant is composed of units of commercial apparatus so co-ordinated and arranged as to be very flexible in operation, to be easily manipulated and to involve little or no waste construction.

Part of the contractor's regular stock equipment was utilized advantageously, and the remainder of the plant which was installed is not only adapted to secure the greatest rapidity, efficiency and economy of construction of this work but to be desirable as permanent equipment available for almost any kind of heavy concrete construction.

On the completion of the present contract the plant may be transferred to some other job, or may be sold in the open market for a price which, subtracted from the purchase price, should leave a small difference that would represent a very light unit charge for handling and mixing the concrete.



PLAN AND ELEVATION DIAGRAMS OF CONCRETE MIXING, HOISTING, AND SPOUTING PLANT

The general system is that of mixing the concrete on the site at a point entirely outside of the excavation and construction work, hoisting it to a height of about 120 feet, and then spouting it directly to position in the forms. The special feature is the arrangement by which the concrete is conveyed from the hoisting tower to the geometric center of the construction and thence distributed by a duplex system of pivoted chutes to any point within a radius of about 200 feet, all of the apparatus being kept at a comparatively high elevation with unobstructed clearance beneath it for the operation of the steam shovels, pumps, pump lines, form construction and concreting over every part of the area to be built, thus avoiding all interference, delays, or expense of removing and rehandling plant, equipment or materials.

FIXED PLANT INSTALLED

Excepting electricity for lighting, operating the centrifugal pumps and some minor uses which is purchased from a commercial company, power is furnished by a 250 h. p. battery of three horizontal steam boilers, although two of them, working to capacity, can provide for all the machinery now operated, with a consumption of between 5 and 6 tons of coke per 24-hour day, most of this steam being used in the 8-hour day shift. Ordinarily the principal requirements are for the operations of the two hoisting engines, the pile driver hammer, the concrete mixer, the cement hoist and the concrete hoist and reserve Cameron pumps.

The 1-yard concrete mixer is installed about 10 feet above the surface of the ground in the base of a wooden tower 35 feet high, surmounted by a 10-yard and a 20-yard storage bin for sand and broken stone. The mixer discharges directly into a 1-yard quick-shift bucket hoisted in an Insley steel tower 160 feet high. The bucket automatically discharges into a hopper fixed on a sliding frame at any required height in the tower, from which the concrete is distributed through an Insley continuous line chute suspended from a 1¼-inch plow steel cable led from the tower to the top of the mast of the guy derrick installed on a wooden falsework tower 30 feet high in the geometric center of the building.

From the top of the 70-foot mast the cable continues to anchorage to a deadman located on the site beyond the limit of the general excavation. The end of the cable is looped around a sheave that is shackled to a 2-inch turnbuckle with 2-foot adjustment that is connected to a wire rope loop engaging two horizontal timbers in the bottom of a pit 10 feet deep, backfilled and covered with a heavy load of stone.

The central derrick is independently guyed and is used to support the counterweight chutes and auxiliary chutes in the center of the operation.

MAST AND TOWER OF CENTRAL DERRICK SUPPORTING DUPLEX REVOLVING CHUTES

CONCRETE AND CEMENT HOISTING TOWERS, MIXING PLANT AND AGGREGATE UNLOADING DERRICK AND STORAGE

This derrick is rigged up with bullwheel, and with the use of the boom swinging engine in the base of the derrick structure proper, can be handled by one man without any loss of time. At the end of the 50-foot boom section chute there is suspended from the end of the boom a 50-foot extra-heavy counterweight section chute which in turn supports a 50-foot standard counterweight chute which gives a radius of 150 feet; which radius is increased 60 feet by the use of additional chutes which give a complete working radius of 210 feet from the center of the building.

The entire arrangement of counterweighted truss and boom chutes can revolve 360 degrees around the center of the building and each of the counterweighted chutes can revolve 360 degrees at any point of the concentric circle it makes in the derrick revolution, thus fully commanding all portions of the area of the building. The first truss has a 5,000-pound concrete counterweight and the second one has a 1,000-pound counterweight, while the load suspended from the boom hook is about 20,000 pounds. The chutes have a slope of 1 on 3, which provides for free delivery of concrete at all times.

So far the best day's record is 470 yards with a total force of about 20 men, only 3 men being required to convey the concrete to the forms. The concrete is of medium consistency so that it immediately settles to a horizontal surface in the forms and does not require tamping or spading. At the end of every shift the concrete bucket and the line of chutes are washed out with water to prevent any concrete from adhering or setting on them, and at the commencement of every shift the chutes are also flushed with water to provide for the more easy flow of the concrete.

(To Be Concluded)

Scientific Research by Federal Government Threatened

A public hearing will be held by the Senate and House Conferees on H. R. Bill 11984, commonly referred to as the Nolan Salary Bill, on January 5, 1921, at 10 a. m., in the room of the Committee on Library, Senate end of the Capitol Building.

The U. S. Patent Office is undermanned and its technical employees underpaid. It is fast becoming demoralized by the loss of experienced examiners. The Nolan Bill, as passed by the House, is a meritorious measure and aims to correct this difficulty.

However, Section 10, added by a Senate amendment known as the Cottrell Rider and now under discussion, is highly objectionable and should be opposed. Under this rider inventions developed by employees of the U. S. Government, instead of inuring to the benefit of the public, as at present, would be assigned to the Federal Trade Commission and licensed to private individuals or corporations as the commission may see fit. That such assignment would be made always without political or personal preferences is highly improbable.

The Cottrell Rider provides for establishing a fund from license fees so collected, from which the President would have the power, at his own discretion, to pay money to government employees of his selection who have turned their inventions over to the commission, thus making it practically impossible for the President to grant fair or uniform awards, and leaving government experts who may have made wonderful discoveries of a non-patentable nature, without any chance of reward.

The Cottrell Rider is also objectionable because it has the effect of commercializing government employees by giving them the incentive not to do better research work, but to produce inventions and improvements of a patentable nature as distinguished from those which are of a purely scientific nature. But it is the latter which should receive the most attention of government employees since there is little inducement for private investigator to engage in such unremnuerative research, and if government investigators are enticed away from it it will be almost wholly neglected.

Under the present arrangement many important discoveries have been turned over to the public as the result of government research and no reason is seen for making the radical changes contemplates by the Cottrell Rider.

Blasting a Ditch in Gravel

A few weeks ago we described an instance of opening up a water channel in wet soil by the use of dynamite, in which the writer stated that the method would not have been applicable had there not been an abundance of water in the soil. Recently a similar piece of work was performed by dynamite where the soil was sand and gravel.

The Genesee river near Dansville, N. Y., was found to be cutting away the highway at a point where the river made an oxbow bend. The engineer for the State Conservation Commission decided that a new channel should be dug across the bend to divert the water from the highway embankment and the work was placed in charge of Town Clerk Feeder. The distance across the neck was about 1,000 feet and the soil, as stated, was sand and gravel. A professional blaster was engaged to handle the work and expressed the opinion that it would be practically impossible to blast the dry soil, but agreed to try it. Bore-holes were placed three feet apart and made two feet deep and in each was placed a pound and a half of 50 per cent straight dynamite. Each charge was packed in stiff mud and the bore-holes were filled with the same material. This was found to afford sufficient resistance and, on blasting the holes by means of electric blasting caps, there resulted a clean ditch 9 feet wide and 4 feet deep. The explosives for the job cost $165 or at the rate of about 16½ cents per running foot of channel.

PUBLIC WORKS

Published Weekly
by
Municipal Journal and Engineer Inc.
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba....$3.00 per year
All other countries .....$4.00 per year

Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

CONTENTS

OCEAN AVENUE STORM SEWER—Illustrated... 1
Water Power in San Joaquin Valley 4
Atlantic City's High-Pressure Fire System..... 4
A CONCRETE JOB MECHANICAL—Illustrated... 5
Scientific Research by Federal Government Threatened 8
Blasting a Ditch in Gravel 8
EDITORIAL NOTES 9
Here's to 1921—New Forms of Contract—Increasing Labor Efficiency
OPERATING THE ST. LOUIS FILTERS..... 10
STREET CLEANING IN ST. PAUL 11
WISCONSIN STATE HIGHWAYS 12
THE COST OF TUNNEL ROCK EXCAVATION.. 13
IMMIGRATION NOTES 15
RECENT LEGAL DECISIONS 16

Here's To 1921!

To all interested in public works it promises big.

To public officials it promises material progress in the work of catching up with the deferred construction programs.

To contractors it promises plenty of work, with falling costs and sure profits instead of rising costs and vanishing profits.

To engineers it promises abundance of opportunities for planning and directing these public works.

The money is in hand, labor is beginning to look for work, materials are available and freight cars for delivering them. Everything looks favorable for the biggest year ever in public works construction, if only all concerned will realize that the time for profiteering is over and that moderate profits and large sales will be best for themselves as well as for business generally from now on.

After a year of readjustment and uncertainty as to the future, we can now feel confidence in the trend of events, if not in their ultimate goal.

So let's complete our plans, get our plants in shape, close contracts as early as possible, and get ready to begin, with the first sign of spring, to make 1921 a record breaker in the amount of public work done.

It can be done if we will all come down to earth from the clouds above and up from the slough of despond below, forget the lost sanity of the past five years, and pull together for a return to safe and sane conditions.

Let's go!

New Forms of Contract

One of the developments of the past year has been the evolution of new features in contracting for public works, some of which will probably have a permanent influence upon the contracting business. With prices and wages rising to unforeseeable heights, contractors were not willing to make unit prices on work; while with falling prices later, those awarding contracts were equally averse to binding themselves to fixed unit prices.

Probably the most favorable modification of the cost-plus plan (which seems to be the general form taken by practically all recent modifications of former contracting methods) is that which requires the contractor to present an itemized bid, but provides for increases or decreases based upon fluctuations in cost of materials and wages during the continuation of the contract. It would seem as though both parties to the contract would be amply protected if itemized bids be received as formerly, such bids being based on definitely stated prices for all the materials entering into the work in any quantity and also stated wages for the various kinds of labor employed, with perfectly clear and fair provisions whereby increases or decreases in the cost of the work due to changes in such prices should be added to or deducted from the amounts actually paid for the work. With such a contract carefully drawn, neither contractor nor party of the first part stands to lose or make any amount other than that contemplated by the original contract as fair price and fair profit. In some cases, as in that of the Wanaque dam described in PUBLIC WORKS a few weeks ago, the city practically purchases the materials itself and turns them over to the contractor, while the variations in wages are provided for as just indicated.

With both public officials and contractors earnestly endeavoring to reach a fair basis on which work can be done and a reasonable profit obtained by the contractor whose ability and efforts have earned it, there should be no restriction in the amount of work done next year because of fear that the contract gives an unfair advantage to one party or the other.

Increasing Labor Efficiency

An automobile factory in Detroit reports that with a smaller force working only five days a week they are now turning out a greater product that formerly with a larger force employed six days per week.

Similar conditions are reported from other places and it is generally noted by employers that men are showing a greater desire to make their work satisfactory and are not willing to lose their jobs. There is, to be sure, some talk of shorter hours but now it is chiefly on the side of the employers who can no longer find market for their extra high priced products and either have to discharge some of their men or reduce the working hours, or diminish the pay, and frequently make both of the latter changes. Instead of producing a strike, as it would have done some months ago, this action is accepted generally by the workmen rather than to lose their jobs entirely.

Eventually perhaps, a part of the men, despite the lurid protests of their leaders and agitators, will realize that although they may sometimes compel employers to pay unreasonably high wages for a while, they cannot compel them to employ a large force at a great loss continuously. The men can only offer a certain quantity and quality of service at a certain price. It is eventually up to the employer to accept or reject it.

Operating the St. Louis Filters

Describes the method employed for cleaning the filter sand and gravel. Strainer plates were found stopped up and were cleaned by sand blast, gravel and sand were removed and cleaned by water jets, mud balls removed, and the entire forty units put into condition.

In the operation of the water filtration plant of St. Louis during the fiscal year 1919-1920, the rate of filtration varied from a maximum of 98 million gallons per acre per day to a minimum of 73.7 million gallons.

One of the most important features of the operation this year was the cleaning of the filter sand, gravel and plates. A large mound of gravel was discovered in one of the filters and this filter was put out of service, the gravel graded and put back into place. In cleaning out this filter, about 50 per cent of the holes in the strainer plates were found to be stopped up and the gravel so coated with calcium carbonate and other substances that in places it was being cemented together. Other filters were then examined and found to be in much the same condition; mud balls also being found in considerable numbers in the sand. It was thought that some of the aluminum sulphate added to the water in the influent pipes to the filters was being carried into the sand and gravel and was partially responsible for the coating found on the particles of these. Consequently application of aluminum sulphate in such influent pipes was discontinued.

In most of the filters the gravel was found badly ridged, which was due to the holes in the strainer plates becoming stopped up in places and allowing the gravel to become firmly cemented together, and greatly increasing the velocity of the wash water in other parts of the filter. In some of the filters large balls of fine sand grains and mud stuck together were found all through the sand and on the gravel.

Not only were the gravel particles held together, but the grains of sand were covered with a soft coating which could be removed slowly by washing, but could not easily be dissolved and violent agitation was necessary to remove a small percent of it. Hard patches appeared on the bed and the wash water distribution became very unequal.

In order to remove the mud balls the deposits on the gravel and sand, the sand and gravel were washed, 36 filters having been cleaned in this way by the end of the fiscal year. In washing the filter, all of the sand was removed, and the gravel from one-half of the bed. The exposed strainer plates were then cleaned by sand blast, loose anchor bolts tightened and repairs made where needed. The gravel of the other half of the filter was then washed, graded and placed into the half that had been cleaned and the other half of the plates cleaned and washed gravel deposited from the next filter to be cleaned. The sand from the next filter to be cleaned was then washed and deposited on the gravel of the one already cleaned.

The problem of cleaning the sand and the gravel economically was studied carefully and a cleaning plant was constructed consisting of four water jets with ¾-inch nozzles and 1½-inch to 2⅜-inch throats, 4-inch discharge pipes, a stationary sloping gravel screen having four sizes of separation with a hopper under each. Also a sand blast machine was provided for cleaning the holes in the strainer plates. The sand was cleaned by placing one of these jets in each half of the filter bed on top of the sand and discharging into the opposite half of the bed or the opposite end of the same half of the bed, into a wooden box 12 inches square and 4 feet deep containing a series of sloping screens. Water at 100 pounds pressure was used in the jets. In operating, wash water was turned on at from 1-10 to 1-4 the normal rate, which allowed the jet to sink through the sand to the gravel and also furnished means of transporting the sand from the discharge of the jet to the suction at the opposite end of the same half of the bed. Wash water flowed out through

the sewers, carrying away the coating removed by the scouring action of the water passing through the jets and screens.

Sand washing was continued about five hours without aid of any manual labor, and at the end of that time the discharge from the jets was still turbid. Coating amounting to an average of 2.14 per cent of the weight of the sand, or about 7,000 pounds, was removed, leaving about 4.89 per cent still on the sand, which was further reduced by about ½ per cent by again jetting the sand from one half the filter to the other side, where the gravel had previously been placed ready to receive it.

In cleaning the gravel, it was shoveled into the jet and discharged into a box which diverted the water, which escaped through the screens into the sewer. The gravel rolled over stationary screens, assisted by men with rakes, and dropped into four hoppers suspended from the wash-water gutters. It was discharged from the hoppers into a small truck, which was wheeled and dumped where desired on the half bed where the strainer plates had been cleaned.

Broken strainer plates were found in three filters. In one of these, the four lateral channels nearest to the broken plate were found to be completely filled with sand. Broken U-bolts were found in eleven filters.

In cleaning the plates by sand blast about one cubic yard of sand was used per filter bed. One man cleaned the plates in one half bed in a day. The plates cleaned in this manner had over 97 per cent of the holes perfectly cleaned and the top sides of the plates bright. The under side was found to contain a coating which still remains, this coating containing 41 per cent of copper oxide, 38.7 per cent zinc oxide, 10.6 per cent of matter destroyed by ignition, and the balance other mineral matters. The gravel from one bed when washed and passed through the screens lost about 450 pounds of coating material. What material remained was hard and had no tendency to cement the gravel together.

The coating on the sand and gravel was found on analysis to have the following constituents:

	Sand	Gravel
(SiO_2)	0.4 per cent	0.5 per cent
($Fe(OH)_3$)	12.9 per cent	33.0 per cent
($Al(OH)_3$)	17.3 per cent	17.1 per cent
($CaCO_3$)	45.7 per cent	48.9 per cent
($CaSo_4$)	0.3 per cent	0.1 per cent
($Mg(OH)_2$)	10.0 per cent	0.4 per cent
Clay	13.4 per cent	0.0 per cent

The cost of this cleaning per filter unit was $169 for labor, $88 for wash water and $9 for tap water, a total of $266 per filtering unit having an area of 1,400 square feet. The plant used cost $750, or $18.75 for each of the forty filtering units, and will be used for future work, it being expected to jet the sand as described above from time to time, should mud balls or cementation of the sand develop. The cost of jetting the sand of a filter unit for five hours was $35.50, of which $2 was labor and $33.50 for water. In these calculations the wash water was estimated at $20.60 per million gallons, and tap water at $19.61.

Street Cleaning in St. Paul

Hand sweeping by patrol system, auto-sweeper, flushers and squeegees used. Streets oiled with auto-oilers.

The 52.17 square miles of land area in the city of St. Paul contains 395 miles of roads that are graded only, 45 miles of macadam, 36 miles of gravelled roads, 96 miles of paved streets and 5¾ miles of paved alleys.

Of the paved streets, 58 miles with an area of 1,365,000 square yards is cleaned by hand sweeping under the patrol system. The force consists of an inspector at $125 a month, an assistant inspector at $110 a month, 105 to 125 sweepers and 15 shovellers at $2.50 per day of 8 hours, and 14 teams at 90 cents an hour. The total cost of the patrol system last year, including hauling away the sweepings, was $98,508, and the average cost per thousand square yards swept for the season was $72.17. Each sweeper is assigned to a district and sweeps and patrols an area varying from 3,200 to 17,000 square yards. The street railway pavement comprises 280,000 square yards within the patrol district, and the company is charged $23,806 for its portion of the cost of this service.

In 1918 the city purchased an Elgin auto-sweeper machine at a cost of $5,652. This machine is used in sections of the city outside of the patrol district. It cleans approximately 80,000 square yards a day at a cost for operation of 8 cents per thousand square yards. The balance of the paved area is kept clean by the ward crews.

The city owns 7 Studebaker flushers, 6 of which are operated continuously on day shifts and 3 on a night shift; also 8 squeegees which are used on smooth pavements such as asphalt and creosoted blocks. The streets in the business district are flushed at night, there being 7 miles or 146,400 square yards of such streets. The crew consists of a foreman and 3 teamsters who work 8 hours. The Average cost of operating these 3 flushers on the night service is $33, making the cost per mile of street per night $4.64, or 22½ cents per thousand square yards; this including pay roll, oil, waste, gasoline and water, but not repairs to equipment. The average cost of squeegeeing in the business district outside of the night district was 16 cents per thousand square yards for one scrubbing, this not including the cost of removing the dirt from the gutters, which is done by the teams hauling the street sweepings. All paved streets in the residence district are either flushed or scrubbed once a week and oftener where necessary. The total cost of flushing streets for the season was $19,141, and for squeegeeing $6,623. The street railway company paid the city $4,795 for flushing and squeegeeing its portion of the street, and in addition paid the water board for 8,960,629 gallons of wa-

ter estimated as the amount used in cleaning its portion of the street.

During the season, 171 miles of streets were water sprinkled and 164 miles treated with oil. The oil was spread with two Kinney auto-oilers, while for water sprinkling the city furnished tank wagons and hired the teamsters, paying them $150 per month. The auto-oiler distributed 10,000 gallons of Tarvia and 582,113 gallons of road oil at a cost of $4.83 a thousand gallons, this cost including chauffeurs, operators, gasoline, oil and upkeep. In 1919 the oil cost 6.5 cents a gallon as compared to 8.6 cents in 1918.

Wisconsin State Highways

Labor conditions improving and highway contractors eager for work. Day-labor work done at a saving. Equipment housed for the winter at fair grounds.

In the quarterly progress report of the State Highway Division of the Wisconsin State Department of Engineering dated October 1, A. R. Hirst, state highway engineer, states that this year surveys have been made and plans completed for the following amount of road: Concrete paving—federal aid, 96.59 miles; state aid, 143.76 miles. Gravel surfacing—88.66 miles of federal aid and 173.48 miles of state aid. Top soil surfacing—20.68 miles of federal aid. Asphalt paving—0.51 miles of state aid. Earth grading—81.35 miles of federal aid and 237.58 miles of state aid. Shale surfacing—4.71 miles of federal aid. Stone macadam—35.81 miles of state aid.

Owing to the fact that much of the construction work will continue until the middle of November, it has not been possible to compile figures concerning the total extent of this year's construction. During the third quarter of the year the weather conditions were better than for any like period in the history of the department. The labor situation was better than last year and, had it not been for transportation difficulties and shortage of cement, the highway work done would have surpassed all previous records; and in spite of these difficulties the showing was more than good. There are unmistakable indications that the general situation is improving, among these being the increased desire on the part of contractors to undertake work. Early this season it was practically impossible to award contracts on a satisfactory basis, but recently contractors have been almost eager to undertake work.

The State Highway Commission has a number of important day-labor projects under way, some federal and others state aid. North of Oshkosh it completed four miles of eighteen-foot concrete pavement in about ten weeks and expected to finish the job before November. In Washington county about three and one-half miles of eighteen-foot concrete was being laid at a saving of approximately $5,000 per mile over the best bids. A considerable amount of solid rock excavation in another project is being executed at a saving of about one dollar per cubic yard.

Tests were conducted on materials sent to the laboratory with a view to permitting the use of materials which formerly would have been called unsatisfactory, by changing the proportions from those which had been specified for better materials. A field party collected small concrete slabs for making abrasive tests from the concrete jobs in operation, this party also noting the proportions actually being used on the various jobs visited, the consistency of the concrete and general features of the operations. The testing laboratory was also making tests on the use of "Cal" and other substances which are supposed to accelerate the hardening of concrete.

Four field parties have been out making investigations with a view to finding suitable road materials in every section of the state. Reports from these investigations were already in hand and were being used by the division engineers in preparing estimates for the 1921 program.

During the first nine months of 1920 the State Highway Commission prepared and sent 540 bridge plans for bridges having a total length of 15,315 feet and an estimated cost of $2,266,950.

In general, the trunk highways are in better conditions than in any previous year at this time, although the majority are suffering from lack of rain. A few counties have installed motor trucks pulling two cleaners or a four-horse-power grader, and the commission finds that this maintenance is much superior to that done by team patrol, because the cleaners can be weighted sufficiently to do better work than those drawn by horses. Every effort is being made to have all patrolmen clean out ditches and culverts and shape up the roads properly before winter sets in.

During the third quarter of the year the commission received four trucks, two of which were in such poor mechanical condition that they expected to scrap them. The other two were 3½-ton Kelly-Springfields which had seen service but could be placed in first-class condition at moderate cost.

The equipment is being housed in the fairgrounds at West Allis, using a cattle barn, sheep shed and five cattle sheds, one of the latter having been completely remodeled into a shop for winter work. Sufficient machinery and tools have been procured to permit working on these trucks and four power units at one time, and it is expected that about thirty mechanics and helpers will be employed here throughout the winter. At Madison space has been rented for a shop which it is expected to equip so as to handle all pneumatic-tire vehicles in the state fleet. The commission expects to employ from six to ten men at this shop throughout the winter. The commission still is entitled to 107 additional trucks, according to the government allotment and is expecting to receive them during the winter.

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems differently will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

What is the Cost of Tunnel Rock Excavation?

STATE HIGHWAY COMMISSION

December 10, 1920.

PUBLIC WORKS,
New York City.

Gentlemen:

As your subscriber I write asking for the following information:

I am desirous of knowing the current cost per yard of tunnel rock excavation, as I have considerable of this work in view through a part of the Black Hills of South Dakota.

Thanking you,

Very truly yours,
RESIDENT ENGINEER.

Resident Engineer,
State Highway Commission.

Dear Sir:

Your question does not convey enough information concerning conditions and requirements to enable any close estimate to be prepared, but we are glad to give you some very general figures applicable to ordinary tunneling operations, and to outline the controlling factors of such work so that local values can be placed on them in accordance with the governing conditions and thus easily prepare a more accurate estimate.

An experienced contractor familiar with tunnel work in granite, limestone and the gneiss formations of this locality, estimates that under present conditions in ordinarily hard limestone a tunnel heading about 8 or 10 feet square, without bench or sidework, can be driven at a cost of about $1.20 to $1.40 per yard of rock excavation for labor and materials; and that the labor for drilling and mucking would amount to about $1.75 per linear foot of holes drilled, from 8 to 12 linear feet of holes being probably required for each cubic yard of rock excavated, thus making a cost of perhaps $20 per yard, at New York prices, for labor and materials alone. This cost can easily vary from 50 to 100 per cent according to the physical conditions and even more with labor conditions.

COST FACTORS

The principal factors determining the cost of the rock excavation include the dimensions and shape of cross-section, character of rock, length of tunnel, time limit for completion, number of headings, number of shafts, cost of equipment, cost of supplies, cost, efficiency and abundance of labor, location of work, drainage, ventilation, accidents and delays.

The cost per yard for a tunnel having a very small or very large cross-section would probably be greater than for moderate dimensions.

Some of the items diminish slightly with the increased volume of excavation, while others increase in a greater proportion for excessive length of tunnel involving greater cost of removing the muck and for ventilation.

If the tunnel is short enough, and the permissible time of construction is long enough, the lowest cost will probably be obtained by driving it from a single portal, thus involving the minimum power and drilling equipment. If the tunnel is long and located far below the surface, the necessity of sinking one or more working shafts intermediate between the portals will cause extra expense.

A very great difference in the cost of excavation is caused by varying qualities and stratification of the rock, some of which is much harder to drill than other, or requires much more explosives, or shatters irregularly, or is in dangerous condition requiring expensive timbering which may in other cases be wholly omitted.

The other most important factor is that of the labor which cannot be even approximately estimated without knowledge of local supply, quality and prevailing rate of wages, elements which in many parts of the country have increased the unit cost of work from 100 to 400 per cent within the last five years.

In rock tunnel, excepting submarine work, drainage is ordinarily a minor consideration, but if large water-bearing fissures are encountered and the grade is not all down hill from the heading to the portal, extensive pumping may be necessary.

In short tunnels the exhaust from the compressed air drills generally suffices for ventilation, but if the tunnels are very long it may be necessary to provide an additional air supply.

The superintendence, financing, insurance, office expenses, inspection and other overhead expenses should also be added in proper proportion to the direct unit cost of rock excavation.

It is also possible, especially if considerable work in different localities is under way, that some of it may be subject to accident or delay that cannot be foreseen and that will add an unknown quantity to the cost of the work. This,

of course, is generally allowed for as a percentage in the preliminary estimate.

The location of the work is also likely to be a factor, favorable or unfavorable, according to whether it is easy of access by railway or automobile for delivery of supplies and machinery, whether it is near a good labor market or not, whether camps have to be provided for the maintenance of the workmen or not, and whether climate and surroundings are such that the men are contented to remain on the job. The proximity to cities and towns and the probability of interference with labor by agitators are elements that may be important.

Tunnel work, however, has the counterbalancing advantages of being practically independent of climate or season and of being carried on equally well day and night, so that it may be prosecuted continuously twenty-four hours a day under favorable circumstances, thus decreasing the overhead and superintendence charges.

MINIMUM UNIT COST

A short tunnel, driven upgrade and entirely from one portal, through sound, uniform, favorable rock strata with a cross-section large enough to give comfortable clearance for the workmen and small enough so that it can be driven with a full-size heading, will probably give the minimum cost of excavation per cubic yard of rock handled.

For a larger cross-section, where the work is done with one or more benches and with side excavation, the direct cost of drilling and blasting will be somewhat smaller per yard but there will be added expense for a much larger mechanical equipment, and as the width of the tunnel increases the danger from falling rock increases rapidly and there may be very heavy timbering expense that can be reduced or entirely omitted for small headings.

About a practical minimum would be a tunnel 6 feet in diameter of the finished lining, which would require an excavation averaging 7 feet in diameter to allow for irregularities of blasting. This has an area of about 39 square feet with a corresponding volume of about 1½ yards of rock excavated per linear foot of heading driven.

RATE OF PROGRESS

Under ordinarily favorable conditions, in medium hard limestone, this tunnel can be driven at the rate of about 6 feet per 8-hour shift, and one drilling shift and one mucking shift per day can be operated, the remaining time being required for ventilation and other purposes, so that the total advance of the tunnel may average 6 feet per twenty-four hours for a four-man drilling gang and a four-man mucking gang for lengths up to 1,000 feet, above which more men will probably be required for mucking and hauling.

The heading would require about fourteen 1¼-inch holes from 6 to 8 feet long, each of them charged with about 7 pounds of 40 per cent dynamite, and together breaking up about 9 yards of rock.

WAGES AND EXPLOSIVE

Assuming that the dynamite and caps cost 30 cents a pound, the cost of explosives would be about $30 per day. If the cost of labor corresponds to that at present quoted in New York state and in Colorado, which do not vary very much, and assuming that the wages of the drill runners are about the same as those of steam hoist runners, as they are in the east, and that the muckers receive about three-quarters of the wages of the drill runners, they may be assumed at $1 per hour and 75 cents per hour, respectively, making a labor cost of about $70 per day and a combined labor and explosive cost of about $100 per day, equal to about $17 per linear foot of tunnel or about $12 per cubic yard of rock excavated, which would probably be a low estimate. This cost does not cover all of the items properly chargeable to driving the tunnel and without which it would be impossible to make the rock excavation. The principal additional items are for plant equipment, supplies, transportation, supervision, insurance, interest, miscellaneous and overhead.

MINIMUM EQUIPMENT

The indispensible equipment for one small heading includes three rugged air drills (one of them for reserve) mounted on separate columns and each operated by a drill runner and a helper. There should be provided a set of twelve 1¼-inch steels with double taper cross bits. An electric firing machine, wire and detonating caps should be provided with the estimated quality of 40 per cent 1-pound dynamite cartridges for blasting, but fuse, burning about 1 foot per minute, may be substituted for the electric outfit. The air compressor, with a capacity of about 250 cubic feet per minute of air at 100 pounds pressure, must be equipped with a motor of about 60 brake h. p. and a 36-inch receiver 8 feet long. The compressor weighs about 7,500 pounds, the motor weighs about 6,600 pounds and the receiver weighs 1,400 pounds.

About 50 feet of 1¼-inch pressure hose should be provided for each drill and it will be necessary to have at least two small side-dump narrow-gauge cars to remove the muck from the heading to the spoil bank from the portal. The cars may be operated on any kind of industrial track or on light rails most conveniently secured. If the rails have to be purchased new in Pittsburgh they can be secured at a present quotation of about 4 cents a pound and 10 to 20-pound sections should be selected according to the amount and character of future work contemplated. Freight on the rails and other equipment from Pittsburgh or New York would probably amount to about $1.50 per hundred pounds.

DESIRABLE ADDITIONAL EQUIPMENT

The above equipment is absolutely essential for driving the simplest tunnel under favorable condition and must be duplicated for every heading driven, except that it may be possible, if found desirable, to establish a central power plant and install there one or more large air compressors with distribution lines to the different headings, thus eliminating the separate compressors.

For short tunnels or with cheap labor it is better to move the muck cars by hand, but as the

tunnel length increases and the cost of labor rises, it would be more expeditious and economical to haul them by a wire cable operated by a small hoisting engine. A suitable one can be secured weighing only 350 pounds, and can be installed on a drill column, and will pull 100 pounds on a consumption of 150 cubic feet of air per minute at 80 pounds pressure.

If more than one heading are simultaneously driven it will also be a great economy to sharpen the drills with a machine which will weigh about 1,200 pounds and cost about $600.

EQUIPMENT REQUIRED FOR POSSIBLE CONDITIONS

If much water is encountered and does not drain automatically, steam, electric or compressed air pump and long lines of pipe must be installed.

If the heading is driven to a very great distance from the portal or nearest shaft or if poisonous gases are encountered in the rock it may be necessary to provide artificial ventilation by forcing a large quantity of fresh air into the heading and permitting it to escape or exhausting it through the suction pipe.

In unsound or treacherous rock it may be necessary to follow the heading very closely with heavy timber bents and sometimes with a solid wooden roof, strong enough to prevent the rock from falling.

If the headings are driven from the bottoms of shafts, the cost of sinking the shafts, which will be about the same as that of driving an equal length of tunnel of the same size, together with the cost of the hoisting apparatus installed there, must be added to the general expense of the tunnel.

GENERAL CHARGES

To all these expenses must be added the difference between the cost and salvage of the equipment if the latter is purchased or of rental if it is not purchased, together with the maintenance, repairs, supplies and depreciation. Besides this, there are unforeseen expenses, all of which must be added to the cost of labor and explosives in determining the true cost per yard of excavating the rock, which will thus probably be found to equal or exceed the estimate of the New York contractor.

From this general analysis and enumeration of principal items you can readily make an approximate estimate suited to local requirements and conditions, but no preliminary estimate of such work, especially made by men unfamiliar with this class of construction and without accurate knowledge of the character of the rock and all the other details enumerated, can be expected to be accurate.

Increased efficiency of sawmill and woods labor in all sections of the south is reported by the Southern Pine Association. Notwithstanding reductions which have been made in the number of men employed by the companies, an increase in the output is shown. The number of colored men seeking work is much larger than heretofore, this being attributed to the fact that the negro is gradually realizing that he does not fit into northern industries and is returning to his old clime.

Immigration Notes

The introduction in Congress of the Johnson bill, originally drafted to prohibit all immigration for a two-year period, has met many solid objections to this drastic proposal, and its supporters, representing union labor, have offered various modifications and have passed the one limiting the duration of the prohibition to one year and exempting the Philippine Islands. It was justly objected that the bill is extreme and radical, leading to permanent restriction of immigration. It was also opposed on account of the laxity of enforcing existing laws and because it would refuse asylum to oppressed peoples. One senator, wishing to regulate the immigration to the power of assimilation in this country, proposes to replace this bill by one permitting entrance of only 5 per cent of the number of persons of the given nationality already residing in the United States. This would permit at the present time a total admission of 256,469 from all of Southern and Eastern Europe and Asiatic Turkey as against the average immigration in 1914-16 of 738,607. For Northwest Europe it will give a total of 337,602 against the former average of 182,850. It will greatly reduce the number of immigrants from Italy and Russia and increase the number from Germany and the United Kingdom.

The Sterling bill proposed to control the number and quality of immigrants by a board of immigration commissioners invested with broad powers to act in accordance with the industrial interests of the country regarding the number admitted and the preference to those more suitable for our needs. It would provide European agencies for selecting the immigrants and would deal with the activities of steamship companies and with causes of undesirable immigration.

One of the New York daily papers suggests consideration by Congress of subjecting unskilled immigrants to an agreement providing that they should remain for a specified length of time in some allotted section of the country where labor is especially demanded, thus supplying that want at the same time that additional congestion in the large cities is avoided.

There is nearly universal agreement that efficient measures should be taken to exclude undesirable immigrants, concerning which the positive statement was made that "foreign governments are financing the movement of radicals from several countries in Europe to the United States," and that Spain is gathering quantities of anarchists and sending them here.

A special correspondent in Berlin writes: "Germany not only does not object to American proposal to pass a Federal law restricting immigration for two years or even a longer period, but will welcome the action." It is estimated that there are now from 2,000,000 to 5,000,000 German citizens ready to immigrate to the United States but that at present the majority of the German immigrants are going to South America and to Southwest Africa.

Recent Legal Decisions

WHAT CONSTITUTES AN ORIGINAL PAVING?

Frequently, under charter or statute, only the cost of the first pavement of a street is assessable against the abutting owner. As to what is a first pavement under such a provision the Pennsylvania courts give the following definition: "It is essential to such a first pavement as shall exonerate the abutting owner from further charge for improvement that it shall be laid or adopted by the municipal authority, not necessarily by formal ordinance declaring the change, for it is not always convenient or even possible to make such documentary proof, but municipal recognition of the pavement of the street, as such, must appear. The pavement may be of macadam or of anything else. That is a matter of evidence only. If the purpose and intent be wanting, a mere surfacing of the road, however carefully or expensively done, will not be a paving, but if the intent and purpose are present, or may be fairly inferred, then there is a paving, whatever the material may be." Philadelphia v. Eddleman, 169 Pa. 454, City of Chester v. Larkin, 72 Pa. Superior Ct. 204. Where a borough street was paved in accordance with a petition by the abutting owners, and under the borough council's authority, and an assessment levied against the abutting properties in proportion to frontage, there was sufficient evidence that it was the intention of the municipal authorities to convert the road into a paved, improved borough street and that such improvement constituted an original paving in the legal sense.

ASSESSMENTS FOR PAVING BY THE FRONT FOOT RULE

The Pennsylvania Superior Court holds, City of Philadelphia v. Ramsay, 72 Pa. Superior Ct. 185, that a city may assess the cost of paving a street upon the abutting owners according to the "front foot" rule, and without specifying the actual number of square yards of pavement in front of any particular property. The amount due from each owner is for the proportion of the cost of the whole improvement, which the frontage of each property bears to the entire frontage paved.

WITHDRAWAL OF BID BY DEMAND FOR RETURN OF CHECK FOR DEPOSIT

A bidder for the construction of a municipal fire station and library building deposited with his bid a cashier's check as guaranty that he would accept the contract in case it was awarded to him. The bid of another party was accepted, but this party refused to enter into the contract. The city then awarded the contract to the first mentioned bidder, which had theretofore demanded the return of its check, which was refused. The South Dakota Court holds, Gray Const. Co. v. City of Sioux Falls, 179 N. W. 497, that a suit for the amount of the check would lie. There being no statute or ordinance otherwise providing, it was held, that when the bidder demanded the return of its check it exercised an absolute right, which it possessed at all times, to withdraw the offer contained in its bid. Although the bidder did not withdraw its offer until after the bids were opened, it did in effect withdraw such offer when it demanded the return of its check.

CITY'S OPTION TO TERMINATE CONSTRUCTION CONTRACT RENDERING IT UNENFORCEABLE

A city brought an action on a contractor's bond for the faithful performance of a construction contract relating to an additional water supply, the contractor having defaulted and the city having done the work at an expense in excess of the contract price. The Circuit Court of Appeals, Ninth Circuit, holds, City of Pocatello v. Fidelity & Deposit Co., 267 Fed. 181, that, as the contract provided that, if the city for any reason failed to sell bonds due to be sold on a certain date, it might terminate the contract, and the contract was voidable at the option of the city since it required no steps to be taken for the sale of the bonds, the contract was therefore unenforceable for want of mutuality, and the action on the bond was properly dismissed.

VACATION OF STREETS RESULTING IN PRIVATE BENEFIT

If the sole purpose and effect of the vacation of a street or alley are to give away the public right or dispose of it for private use and benefit, it is the duty of the courts, if their authority is invoked by individuals injured by the vacation, to declare the act beyond the power delegated, unless conditions are such as to amount to an equitable estoppel against such individuals. It is not ground for declaring the purpose of a vacation of a street or alley beyond the power of a city council that the vacation will result in substantial benefit to an individual or individuals. The Illinois Supreme Court points out, People v. Benson, 128 N. E. 387, that this is always the case where the city has the fee, in which case it reverts to the original dedicator, or where the city has only an easement, of which the fee is relieved by the vacation. If property devoted to public use is no longer needed for such use, or there is any benefit to the public from the vacation, the courts will not substitute their judgment for that of the legislative body concerning the extent of the benefit or the expediency of the vacation.

EFFECT OF CHANGE OF GRADE AFTER GRADING CONTRACT LET

In an action on special tax bills for the cost of grading a street, the Missouri Supreme Court holds, Commerce Trust Co. v. Keck, 223 S. W. 1057, that a change in the grade of a street after a contract to grade it has been let, is no defense to tax bills for work performed according to the contract. The contractors' right to perform their contract and be paid for it is not impaired by the city's conduct in changing the grade.

NEWS OF THE SOCIETIES

Jan. 10—HARTFORD BRANCH, CONNECTICUT SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. City Club, Hartford, Conn.

Jan. 11—TOLEDO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Toledo Commerce Club.

Jan. 14—COLUMBUS SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Engineers Club, Southern Hotel.

Jan. 18—WATER POWER LEAGUE OF AMERICA. First annual meeting. Engineering Societies' Building New York City.

Jan. 19 — INTERNATIONAL CUT STONE CONTRACTORS' AND QUARRYMEN'S ASSOCIATION, Inc. Annual meeting. Congress Hotel, Chicago, Ill.

Jan. 19 — AMERICAN SOCIETY CIVIL ENGINEERS. New York City.

Jan. 25 — ATLANTA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with Atlanta Section, A.S.C.E. Carnegie Library.

Jan. 25 — PHILADELPHIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Engineers Club of Philadelphia.

Jan. 25-27—CANADIAN NATIONAL CITY PRODUCTS ASSOCIATION. 19th annual convention. Carls-Rite Hotel, Toronto.

Jan. 25-27 — THE AMERICAN WOOD PRESERVERS ASSOCIATION. Place of meeting to be announced later.

Jan. 25, 26, 27—ASSOCIATED GENERAL CONTRACTORS. Annual meeting, New Orleans. Secretary's Office, Washington, D. C.

Jan. 28 — COLORADO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Metropole Hotel.

Jan. 31-Feb. 5—NATIONAL BRICK MANUFACTURERS' ASSOCIATION AND COMMON BRICK MANUFACTURERS' ASSOCIATION OF AMERICA. Joint meeting. Hotel Pennsylvania, New York City.

Feb. 1-2—NEW YORK STATE ASSOCIATION OF BUILDERS. Convention. Rochester, N. Y.

Feb. 1, 2, 3—ONTARIO PROFESSIONAL MEETING in conjunction with the annual meeting of the Engineering Institute of Canada. Toronto.

Feb. 9-12 — AMERICAN ROAD BUILDERS' ASSOCIATION. Eighteenth annual convention, eleventh American Good Roads Congress and twelfth National Good Roads Show. Coliseum, Chicago, Ill.

May 17-19—NATIONAL FIREMEN'S ASSOCIATION. Twenty-third annual convention. Fort Wayne, Ind.

June 7-9—NATIONAL FIRE PROTECTION ASSOCIATION. Annual meeting. San Francisco, Cal.

June—CONFERENCE OF MAYORS AND OTHER CITY OFFICIALS, State of N. Y. 12th Annual Conference. Elmira, N. Y.

June 6-10, 1921—AMERICAN WATER WORKS ASSOCIATION. Annual convention at Cleveland, Ohio. Secretary, J. M. Diven, 153 West 71st St., New York.

ADDRESS TO THE BOSTON SOCIETY OF CIVIL ENGINEERS

On November 10, T. Chalkley Hatton, chief engineer of the Milwaukee Sewerage Commission, addressed the Sanitary Engineering Section of the Boston Society of Civil Engineers. Mr. Hatton described the activated sludge tests and the plans for the activated sludge plant at Milwaukee.

AMERICAN ASSOCIATION OF ENGINEERS

February 25, 1921, has been set as a tentative date for the national conference which the American Association of Engineers is planing to hold on the question of engineering publicity. The purpose of the conference is to prepare a program for national publicity for the engineering profession based on the need for informing the public of the service which engineers are performing for it, and asking the public for assistance. The conference is also to devise plans for securing this publicity, and particularly to enlist the cooperative assistance of engineering publishers and engineering societies in this movement for publicity.

REVISION OF THE CONSTITUTIONS AND BY-LAWS OF THE A. A. E.

A new constitution has been prepared by the Committee on Revision of the Constitution and By-Laws of the A. A. E., which is now in the hands of a committee for final criticism before being presented to the membership. It will be voted upon at the next convention.

NEW CHAPTERS OF THE A. A. E.

The American Association of Engineers has conferred chapter charters upon members petitioning from Jacksonville, Fla.; Muskegon, Mich.; University of Arkansas; and Lewiston, Mont. A club has been authorized at Rams Horn, Texas.

EIGHTH NATIONAL CONFERENCE ON HOUSING IN AMERICA

The eighth National Conference on Housing in America was held in Bridgeport, Conn., on December 9, 10, 11, 1920. The situation was considered from many points of view, interesting papers being read by well-informed men. Among these were "What Is a Fair Rent?" by Harold G. Aron, attorney, New York City; "The Holding Over of Tenants in Possession of Premises," by E. G. Sammis, counsel, Housing Committee, New York Legislature; "Stimulating New Construction," making financing easy, exemption from taxation and other subsidies, by Lawson Purdy, former chairman, Board of Taxes and Assessments, New York City; Control of Luxury Building; Government Housing, by Lawrence Veiller, secretary of the National Housing Association, New York City; "Housing in France," by George B. Ford, city plan consultant, author of the plans for the New Rheims; Co-operative Housing, by E. A. MacDougall, president, Queensboro Corporation, New York City; Investing in Dwelling House Mortgages, by Walter Stabler, comptroller, Metropolitan Life Insurance Co., New York City; Using National Bank Funds, by Edmund S. Wolfe, president, 1st Bridgeport National Bank, and president, Bridgeport Housing Co.; Proposed Federal Building-Loan Bank System, by Charles O'Connor Hennessy, chairman, Federal Legislative Committee, U. S. League of Building and Loan Association; A New Idea as to Landlord and Tenant, by George Woodward, M. D., Philadelphia; Lessons from Bridgeport's Housing Work, by W. H. Ham, manager, Bridgeport Housing Co.; Methods of Reducing Costs, which subject was treated under two headings, Eliminating Waste, by Waddy B. Wood, architect, Boston, and Factory Production, by Robert Tappan, architect, New York City; New Kinds of Materials, by Leslie H. Allen, engineer, Springfield, Mass; Transit and Coal as Factors in Cost of Materials, by Franklin T. Miller, U. S. Senate Committee on Reconstruction and Production; Unwise Building Laws, by Grosvenor Atterbury, architect, New York City; Standardization of Parts; Is America Ready for the Garden City? by Harry Foster Burns, Dorchester, Mass.; Consequences of the Housing Shortage—room overcrowding, the effect upon health and morals, the effect upon industry, by Henry S. Pitts, of the Aberthaw Construction Co., Boston. In addition to these papers, the subject was studied by a motor trip on Friday afternoon, December 10, inspecting the Bridgeport housing developments; and a motion picture illustrating English garden cities and villages.

FEDERAL HIGHWAY COUNCIL

A meeing of the sub-grade committee of the Federal Highway Council was held on November 22 and 23 at Wilmington, Del., under the chairmanship of Gen. T. Coleman DuPont of New York City. The subject for discussion was "Why Highways Fail," in which many prominent men took part, including W. P. Blair, of Cleveland, Ohio; C. M. Upham, state highway engineer of Delaware; and S. M. Williams, chairman of the Federal Highway Council.

THE PHILADELPHIA POST, SOCIETY OF AMERICAN MILITARY ENGINEERS

At a meeting of the Philadelphia Post of the American Military Engineers held recently at the Engineers' Club of Philadelphia, the constitution and by-laws of the local post were adopted. The following officers were elected for next year: Col. W. B. Ladue, commander; Major Marshall R. Pugh, vice-commander; Major H. W. Goddard, adjutant; Capt. J. C. Hinton, finance officer. The following staff officers were elected for two years: Lieut.-Col. Henry S. Spackman, Major Thos. W. Battin and Capt. Clarence Roberts; and for one year, Capt. R. W. Robinson, Lieut. Robert L. Harding. Regular meetings are to be held the fourth Thursday of each month during the winter.

THE LOUISIANA ENGINEERING SOCIETY

The regular meeting of the Louisiana Engineering Society was held on Monday, December 13, at 8 p. m. The technical exercises of the evening consisted of a paper by Captain E. B. Latham, entitled, "Work of the U. S. Coast and Geodetic Survey." Officers were then nominated for the coming year.

BRITISH INSTITUTION OF CIVIL ENGINEERS TO INCREASE DUES AND AVOID DEFICIT

To avoid a threatened annual deficit of more than $50,000, due to increased expenses for publication and administration, the council of the Institution of Civil Engineers (London) has decided that membership dues be raised to provide an additional income of about $60,000 at normal rate of ex-

change. Under the proposed schedule the annual dues will be $35 for resident members, $27.50 for non-resident members in the United Kingdom and $22.50 for non-resident members abroad. For associate members the annual dues will be $22.50 for resident members, $20 for non-resident members in the United Kingdom and $17.50 for non-resident members abroad. For students the dues will be $10 annually.

MANITOBA ENGINEERS TO ENFORCE SALARY SCHEDULE

The Manitoba branch of the Engineering Institute of Canada is asking its members to sign a pledge not to accept a salary lower than those listed on a schedule prepared by the remuneration committee for different branches of professional service. The minimum salaries are from $3,600 to $10,500 a year; and a maximum is suggested also, except for the highest positions. Any engineer who does not receive the salary recommended for his class of service will be assisted in obtaining other employment at adequate remuneration and will receive moral and financial support. Records of all engineers in the employ of large corporations and industries, with their positions and salaries, will be kept, and when the salary is below the schedule, the employer will be requested to appoint a representative to discuss the matter with the committee, with a view to adopting the schedule rate.

CONFERENCE ON EMPLOYMENT AND EDUCATION

A meeting of the Conference on Employment and Education, sponsored by the American Association of Engineers, was held on November 12, 1920, at Chicago. The questions of education, especially of engineers, and the placing of graduates in their proper positions were ably discussed by well-known men.

AMERICAN CONCRETE INSTITUTE

The next convention of the Institute will be held in Chicago, February 14, 15 and 16, at the Auditorium Hotel. The program committee, consisting of the secretary, W. M. Kinney, and Charles R. Gow, urges the early completion of reports and papers for presentation at the convention. The subjects to be discussed are Oil Tanks, Formula for Spiral Columns, Sewers, Concrete Houses, New Fields for Research, Slag Aggregate, Standards for Concrete Products, The Engineering Federation, and The Shrinkage of Mortars.

Although the Institute was obliged to drop from its roster about 25 members who neglected to indicate their willingness to pay the annual dues, the membership is increasing rapidly, applicants including engineers from all over the world.

Robert W. Lesley, who for years has been treasurer of the Institute, has expressed his desire to be relieved of the work and responsibility of that office. Accordingly, the work of the two offices of treasurer and secretary is to be consolidated in one man.

The nominating committee of the Institute which met in New York on October 26 has handed in the following list of nominees: For president, H. C. Turner, New York; for vice-president, W. P. Anderson, Cincinnati, Ohio, and W. M. Kinney, Chicago, Ill.; for treasurer, Harvey Whipple, Detroit, Mich.; for director, third district, Ernest Ashton, Allentown, Pa., and F. R. McMillan, New York; for director, fourth district, J. C. Pearson, Washington, and L. R. Ferguson, Philadelphia, Pa.; and director, fifth district, A. R. Lord, Chicago, Ill., and D. A. Abrams, Chicago, Ill.

PERSONALS

Lamb, John J., has been appointed safety engineer at the headquarters office of the National Safety Council, succeeding R. H. Guerrant, who has left the staff to take up sales engineering work with the Industrial Appliance Co. of Chicago.

Gillespie, J. T., has resigned as engineer in charge of equipment, Milwaukee Highway Commission, to accept a position as assistant to the president of the Marquette Cement Manufacturing Co., Chicago.

Stephens, U., formerly resident bridge engineer, Runnels County, Texas, has been appointed county engineer of the same county.

Wilson, Henry H., Hughsville, Pa., for the past eight years connected with Winston & Co., of New York City and Richmond, Va., has been elected president of the Associated Pennsylvania Highway Contractors.

Arnold, E. M., formerly county engineer, Boone County, Ky., has accepted a position as assistant division engineer in the Second District, State Highway Department of Georgia.

Fellows, F. L., has been appointed consulting engineer to the Saskatchewan Water Commission.

Foreman, A. E., formerly chief engineer, Department of Public Works, Victoria, B. C., has resigned to enter private practice.

Green, A. M., has been appointed county engineer of Modoc county, California.

Hess, Otto S., has been appointed managing engineer, Kent County Road Commission.

Hogan, Joseph V., is in charge of the concrete work for the naval dry dock at the League Island navy yard, Philadelphia, which is to be the largest dry dock in the United States.

Kaufman & Levine, consulting engineers, have moved their offices to 56 Pine street, suite 1600-02, New York City.

Lake, Forest, Sanford, Fla., has been appointed member of the State Road Department of Florida.

Lautz, George, formerly chief engineer of the U. S. Forest Service, District 1, has been appointed assistant to T. W. Norcross, chief engineer in the Washington service.

Lewis, Major George A., has been appointed chief engineer and superintendent of the Auburn Water Board.

Osgood, Manley, formerly city engineer of Ann Arbor, Mich., has accepted a position as manager of the Ann Arbor Asphalt Co.

Paddock, Eugene H., formerly assistant sanitary engineer in the U. S. Public Health Service, has been appointed resident engineer with the Tayford Company, Inc., Lee, Mass., on a hydro-electric development project.

Paxton, W., has been appointed consulting engineer for the city of Akron in connection with the handling of city garbage and street cleaning.

Seelye, Elwyn E., and Fraser, Edwin A., consulting engineers, have opened offices at 101 Park avenue, New York City. A. L. Stevenson will have charge of the designing department.

Sherman, J. R., has been appointed for the Kittitas Reclamation District in Washington.

Stockbridge, David F., has been appointed chief engineer of the Briggs Company, Lansing, Mich.

Taylor, Percy B., consulting structural engineer, died October 21, in Newark, N. J.

Volz, Charles A., has been appointed chief of the Division of Light, Heat and Power of the New York State Public Service Commission, Second District, Albany, N. Y.

Warriner, Thomas R., consulting engineer with offices at 324 Downs building, Cedar Rapids, Ia., is specializing in the design, inspection and superintendence of bridges, concrete construction, paving, sewers and water works.

Adee, E. O., formerly assistant engineer on road work in Hamilton county, Kan., has recently been appointed resident engineer of Federal Aid Project No. 49 in Ottawa county, Kan.

Dick, Howard L., acting city engineer, has been appointed city engineer of Kingston, Ont., Canada.

Weeks, Lt.-Col. W. C., Corps of Engineers, U. S. A., has recently been assigned to duty as assistant to the district engineer at the Wilson Dam, Florence, Ala.

Taylor, Ernest A., recently district engineer for Fayette county, W. Va., is now with the Missouri State Highway Department as project engineer of Division No. 1, St. Joseph, Mo.

Holbrook, Frank, has recently been appointed superintendent of highways for Webster, Mass.

Baldwin, Ward, consulting engineer for the Cincinnati Rapid Transit Commission and professor of civil engineering at the University of Cincinnati, died on November 15.

Clarke, Thomas W., engineer for the Standard Oil Co. of New Jersey, died in Tampico, Mexico, on October 28. From 1902 until his death, with the exception of a few short periods of time, he was connected with the Standard Oil Co., his last assignment being in Tampico, Mexico. While there he promoted many projects to benefit not only the oil companies, but the whole community. Among these were the dredging of the Chijol canal; increasing the Tampico water supply; improvements to the Tampico and Tuxpam harbors; and the cleaning up of Tampico and Tuxpam to prevent an epidemic of yellow fever.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

HIGH EFFICIENCY PUMPING MACHINERY

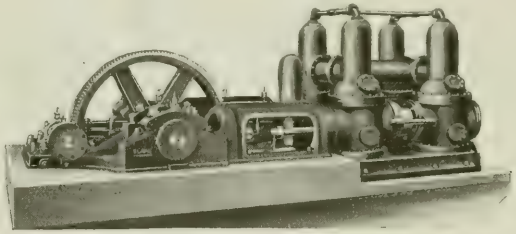
The new catalog H-40 of the Blake Pump and Condensor Company is devoted to the description and illustration of high-grade steam pumping apparatus of which the predominating feature is the application of the Blake Fitchburg high efficiency four-bearing type power end to such types of fluid ends as have been developed for special services. The power end has two one-piece frames, each containing two main crank-shaft bearing jaws cast integral, and are rigidly connected so as to form essentially a single piece. The alignment of all the main bearings is insured by adjustment wedges that merely produce increased friction so that excessive strains may occur without affecting the alignment.

The permanent alignment, the closeness of the rotating element to the foundation, the reduction of friction, and the exclusive use of single-reduction herring-bone gears, secure unusual efficiency of operation. The pumps are designed to be driven by any motor power that is most modern, least expensive in initial cost, and simple in operation, such as electric motor, oil engine, belt, etc.

The DCS is a duplex outside center-packed plunger pump of the dome type, designed primarily for waterworks and for other duty, for handling moderate or large volumes of water up to pressures of 250 pounds per square inch. It has large and unobstructed water passages without sharp angles and with valves sufficient in size and number to reduce the velocity to the medium. There are four separate cylinders mounted tandem on suction boxes front and rear, providing for a constant even water surge. The suction and discharge valve decks are removable, as are the plunger stuffing boxes and the plunger heads. For general service the valves are of rubber with valve seats, guards, springs and stems of bronze. The similar pump, type DCI, is designed for waterworks and general service where the pressure does not exceed 250 pounds.

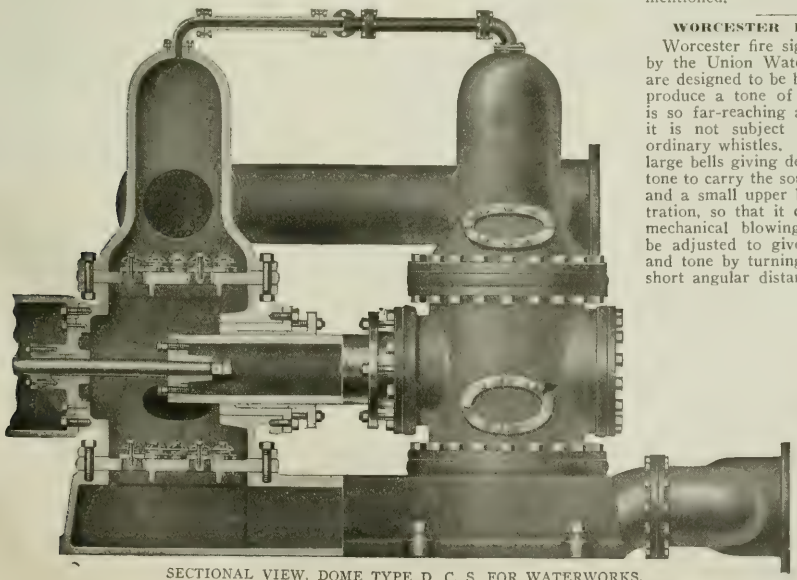
Type PC is notable for its flexibility, water is handled and the pot type is preferred. The fluid end has four separate cylinders, two on each side mounted tandem. A very special feature is a combination of removable plunger stuffing boxes and master top flanges on cylinders and manifolds, thus enabling stuffing boxes and plungers to be changed after installation if conditions require it.

Type PE is similar to type PC and is intended for moderate or large quantities of water up to pressure of 1,500 pounds per square inch. Several other types for high pressure duty and for special service are described and details are shown of by-pass, operating,



DUPLEX OUTSIDE CENTER PACKED PLUNGER PUMP INTEGRAL TYPE

is built in a large number of sizes, and for pressures up to 1,500 pounds per square inch, is adapted to miscellaneous purposes where a large quantity of discharge, suction, general service and high-pressure valves, and of the important construction features, and cross-sections of the principal types mentioned.



SECTIONAL VIEW, DOME TYPE D. C. S. FOR WATERWORKS.

WORCESTER FIRE SIGNALS

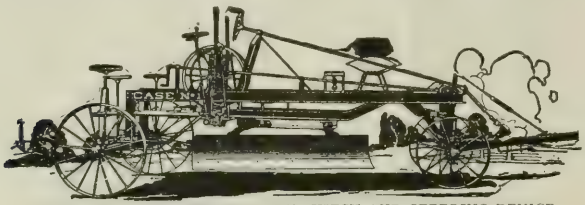
Worcester fire signals manufactured by the Union Water Meter Company are designed to be blown by steam and produce a tone of great volume that is so far-reaching and distinctive that it is not subject to confusion with ordinary whistles. The signal has two large bells giving depth and volume of tone to carry the sound for many miles and a small upper bell giving it penetration, so that it can be operated by mechanical blowing devices and can be adjusted to give different volume and tone by turning the bells through short angular distances.

CASE ROAD BUILDING EQUIPMENT

Apparatus for highway construction that is manufactured by the J. I. Case Threshing Machine Company includes among the lighter units, graders, drags, scrapers and plows.

Graders are built in four standard sizes having various special features, including extension hitch and steering devices, extensible and pivotal axles, full circle blade support, ball and socket joint, and convenient operation by large handwheel and foot pedals for regulating the depth of cuts.

The extension axle feature makes it possible to set one or both of the rear wheels beyond the body of the grader so as to travel outside the pile of dirt moved by the mouldboard while the other wheel travels in the bottom of the ditch.



GRADER WITH EXTENSION AXLES, HITCH AND STEERING DEVICE

The extension hitch and steering device enables the tractor to be operated on the crown of the road while the grader follows in the ditch. One tractor can haul two graders in parallel, or in tandem; the smallest size grader being hauled by two, three or four horses while the larger sizes require a tractor.

The standard gauge road drags are built in three sizes with 8-foot and 10-foot blades, 7 inches wide, that are hinged to a malleable iron knee at the center, and are reversible, giving double edge wear. The blades are adjustable so that the drags will draw at any angle and the material can be dumped at any time by the hand lever. The Winner drag is lighter and smaller and is made in only one size, 8 x 33 inches, and weighs 250 pounds.

The wheel scrapers are made in three sizes with capacities of 9, 14½ and 17 cubic feet, adapted respectively for light, heavy and extra heavy work and for short hauls and long hauls. The tongue scraper is recommended for leveling roads, cutting, cleaning and filling ditches and for irrigation work, and is made in one size, 48 inches wide.

Case road rooters for tearing up hardpan, cement, concrete or macadam or gravel roads have reversible tool-steel points and require from two to twelve horses or a traction engine to draw them.

The Sidney grading plows are made in three sizes, to be drawn by from two to eight horses and are adapted to the first cut in highway and railway grading and for tearing into old road beds and stony ground.

TEXACO ASPHALT PAVEMENT REPAIRS

The Asphalt Sales Department of the Texas Company has just issued a booklet on how to save worn brick pavements with Texaco asphalt. It states in a plain, concise, non-technical manner the exact method of procedure in using Texaco asphalt to surface worn brick pavements. Aside from giving the steps in construction in words, there are also diagrams which illustrate the work thoroughly and are supplemented by photographs, graphically illustrating the exact steps in this construction. Copies of this booklet may be obtained by a request directed to PUBLIC WORKS or to the Texas Company, Asphalt Sales Department.

Worn brick pavement before repairs
After filling depressions
Covered with asphaltic concrete binder
Finished repairs with sheet asphalt surface.

INDUSTRIAL NOTES

HENDRICKS' COMMERCIAL REGISTER

Hendricks' commercial register of the United States for buyers and sellers is a reliable Annual Register containing full lists of producers, manufacturers, wholesale dealers, principal jobbers and consumers, listing all products from the raw material to the finished article, together with the concerns handling these products from the producer to the consumer.

A complete list of architects is also given, together with a carefully selected list of contractors and of all materials, specialties, apparatus, etc., used in the building and construction industries. A special feature is a full list of machine shops and foundries throughout the various states.

The Register is so arranged that information can be quickly obtained by either a buyer or a seller.

The lists for buyers and purchasing agents are grouped under headings represented in the index by about 48,000 classifications and specialize minutely in the different products.

The lists for sellers include architects, automobile builders, brick manufacturers, canners, contractors, machinery manufacturers, steam fitters' supplies and many other lists of great importance to sellers. Many lists are arranged by states so the seller can readily select the part of the country he desires to cover.

NEW BLAW-KNOX OFFICE

Blaw-Knox Company, of Blawnox (Pittsburgh), Pa., has established a new sales district in the South, with headquarters in Birmingham, Ala., in charge of Prescott V. Kelly, formerly connected with the executive sales department at Pittsburgh. Mr. Kelly will be pleased to answer inquiries concerning any of the various products of the company. The Birmingham office is located at 408 American Trust building. In addition, the Blaw-Knox Company has district offices in New York, Chicago, Detroit, Boston, Baltimore, San Francisco and Sheffield, England, for the distribution of Blaw clam-shell buckets, Blaw steel forms for concrete construction, Knox water-cooled equipment for high temperature furnaces, Prudential sectional steel buildings, Quixet garages, transmission towers, fabricated steel products and pressed, riveted and welded steel work of every description.

CHARLES F. AMES & COMPANY

Charles F. Ames & Company, engineers for power plant equipment, 90 West street, New York, announce their preparation to assist in the solution of any problem pertaining to the selection and installation of power plant equipment, pumping machinery and oil mill equipment, representing the product of the Harrisburg Foundry & Machine Works, automatic steam engines; S. Morton Fiske, hydraulic equipment; Buckeye Iron & Brass Works, oil mill and refining machinery; Blake Pump & Condensor Company, Midwest Engine Company, turbine centrifugal and deep-well pump; Anderson Foundry & Machine Company, oil engines; John H. McGowan Company, steam pumping machinery; The Roger-Higgins Company, oil burning equipment; and the Platz Iron Works, repair parts.

The American Wood Pipe Company has opened offices at 140 Dearborn street, Chicago, and at 30 Church street, New York.

J. C. Kopf, formerly manager of the engineering department of the Duff Manufacturing Co., has been appointed research engineer and placed in charge of a newly established research department. F. W. Schwerin has been promoted to manager of engineering.

Colorado is interested in several proposed diversions of water from the western to the eastern slope through tunnels, of which one or more of the three proposed state and railroad tunnels may be modified to serve as carriers.

PUBLIC WORKS.
CITY COUNTY STATE
A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1927, under the Act of March 3, 1879
Vol. 50 FLORAL PARK, JANUARY 8, 1921 No. 2

Manhattan Borough Asphalt Plant

Improvements effected and planned include pumping asphalt from tankers to storage, operating sand drier by electric motor, unloading sand and stone by electric crane, handling stone dust with barrel elevator, elimination of trailers, installation of asphalt reclamation plant, standardization of equipment, and construction of garage extension and machine shop.

The municipal asphalt plant of the Borough of Manhattan, New York, was built several years ago and has been operated solely to provide for maintenance and repairs of the borough pavements, all of which are built under contract and kept in order by the city forces. The plant occupies all of the block between 90th. and 91st. street facing on the East river and has an area of about 200 x 500 feet, with a bulkhead about 270 feet long in water 15 feet deep that provides for unloading two large scows simultaneously. The building, plant and machinery are arranged substantially as shown in the plan published on page 772 of Municipal Journal, November 18, 1915, in a description of the plant and its operation. The general features of arrangement and installation are now substantially as there described except for improvements that have been made and are contemplated, the principal ones of which will be described in this article.

The plant has a nominal capacity for the production of about 4,800 yards of binder and surface courses of asphalt pavement per 8 hour shift and at the present time, under the restrictions of freight, materials, prices, labor and other difficulties, is turning out an average of about 3,500 yards per shift with a force of about 22 of the total force of 60 men at the plant, while an average of 11-men asphalt gangs each lay 150 square yards per day besides some double gangs that lay about 600 yards each. Street work is continued through the fall and winter till the snow attains a depth of 3 inches and is resumed when the snow disappears, thus making an average of about 10 working months per year, which, last winter, on account of the extraordinarily severe weather, was reduced to about 9 months.

PUMPING ASPHALT

Originally the asphalt was received solid in barrels that were broken up, stripped from the asphalt, and the latter elevated to the service tanks and dumped in them by hand, thus involving a considerable amount of labor and loss of time. This system has been superseded by that of direct pumping from tank boats in which the asphalt is heated sufficiently to maintain it liquid. As soon as the boats have been moored at the bulkhead, live steam from the 150 h. p. battery of Babcock and Wilcox boilers that supply power for the plant is turned into the tanker to maintain the heat previously supplied by tug boat connections. Connections are made to the 6-inch pump line 250 feet long and the pump on the tanker delivers the load of about 40,000 gallons of asphalt to the three 35,000-gallon storage tanks elevated about 40 feet on steel towers adjacent to the mixing room.

The asphalt is pumped through a line of screwed steel pipe supported on the tops of brick piers and containing a 1-inch live steam pipe to prevent the liquid asphalt from cooling in transit. The storage tanks are also kept hot by interior steam coils so that the asphalt is never allowed to cool and is always ready to be drawn into the service tanks.

As soon as the storage tanks have been filled, the operator there signals the pump man on the tank boat, the valve at the top of the line is closed, and the lower end of the line is allowed to discharge into 6 or 8 barrels that receive the contents of the pipe line. At convenience these barrels are carried up to the tanks and are there inverted on an overhead rack and left to gradually melt and empty their contents into the tank, thus saving a considerable quantity of asphalt that might otherwise be wasted.

The excessive vibration in the pump line has strained the slender brick piers that support it so that they have occasionly been broken. This defect is to be remedied by capping the piers with horizontal steel plates on which will be placed nests of gas pipe rollers, retained between guides, and supporting movable top plates to which the gas pipe will be bolted thus enabling the latter to move back and forth longitudinally without straining the brick piers.

HANDLING SAND AND STONE

At present the coal, sand, and stone barges are unloaded by a one-yard clam-shell bucket operated by the boom of the steam derrick, which delivers to

dump cars on a wooden trestle 400 feet long, which carries them over the tops of the storage bins, into which they are dumped through openings in the roof. The loaded cars run from the bulkhead to the bins by gravity and are hauled back by an automatic counterweight rope. This arrangement will soon be superseded by an electric unloading and transferring apparatus consisting of a locomotive crane with 50-foot boom operating the clamshell bucket which will deliver to a portable hopper of 10 tons capacity from which it will be drawn off by a self closing valve operated from the bottom. This hopper of 90 cubic feet capacity, will travel back and forth on a car provided with independent locomotive power, from the locomotive crane to the storage bins. The crane will operate on a steel plate girder trestle, like a railroad viaduct, which will have a lower track on which the hopper car will run clear of the crane. Contracts have already been awarded for the installation and part of the concrete piers on pile foundations have been built for it. This improvement will very much expedite unloading materials, and is expected to materially reduce the cost of handling.

HANDLING STONE DUST

The stone dust, of which about 1400 bags (60 tons) per day are required for 4,800 yards of pavement, is received in 100-pound bags shipped on barges and unloaded by the contractor, who delivers them over an industrial track and piles them in a brick storage house of 800 tons capacity, in an overflow wooden shed of 500 tons capacity, besides 200 tons stored on the mixing floor for emergencies. The distance from the bulkhead to the storage does not exceed 200 feet, and if the delivery and piling were not provided for in the contract, an economy might be effected by the installation of a simple conveyer system that would automatically transfer them from the boat to storage. At present the bags are handled from storage to the mixer by an average force of five laborers, which it is expected will be reduced to 2 by the introduction of a barrel elevator that will operate quickly and save moving the bags transversly a considerable distance by hand.

DRIER DRUMS

For the operation of the asphalt plant there is installed a 150-h. p. horizontal Corliss engine that is ample for the purpose but is not provided with sufficient transmission facilities, so one of the 24 x 5-foot sand drums is directly operated by a 20-h. p. electric motor. This motor was originally installed in the dry room where it was impossible to protect it from the great amount of dust and heat in the atmosphere. It has therefor been recently moved to a location in the adjacent engine room and drives the drum through a short transmission shaft and miter gears which enable the motor to be throughly protected from the dust and be kept under the constant observation of the engineer. Great care is taken to provide for the continuous operation of the asphalt plant and, with the exception of the big drum, all parts are kept in duplicate, some of them like gears, that are most subject to injury, are kept in larger numbers so that no delay is ever experienced in providing new parts for repairs or maintenance.

A GARAGE AND REPAIR SHOP

Three years ago a new one-story 48x112-foot brick garage was erected on the 91st street and Avenue A corner of the plant and the original garage was converted into a machine shop. Plans have been drawn and contracts are about to be let to extend the new garage to 90th street by an addition of an 88x48-foot two-story building. When this extension is completed, the machine shop will occupy the second story of the new building. This arrangement will afford better working conditions for the machinists in the way of light and air, less interruptions, etc. This floor will also have a dustproof compartment for the painter where all enamelling of touring cars will be done. Entrance to this second floor will be gained by a ramp, extending into the yard at about a twelve per cent grade, which saves the space in the garage and machine shop that would be taken up by an elevator. The cost of an elevator is considerable and there is also an upkeep and operation expense and a possible chance of it being out of order at a critical time. The ramp overcomes all the above conditions.

At present compressed air for pneumatic tires is furnished by a small electric pump mounted on a little truck that is wheeled from place to place to serve the different antomobiles, about 20 of which leave at about the same time. This is being replaced by a stationary automatic electric pump mounted on the wall and delivering to a receiving tank connected to distributing lines running around the garage and having ten outlets commanding all parts of the place and enabling many different tires to be inflated simultaneously. As this system requires a pressure of 80 pounds or more, it may prove advisable to extend the pressure line to the machine shop and provide outlets there for the operation of small pneumatic hand tools.

The machine shop is equipped with drills, planer, shaper, lathes, and other tools operated by individual electric motors and is supplemented by an excellent smith shop with several forges, power hammer, grinding wheels, and other appliances sufficient for all repair work and for simple construction. In these shops considerable work is now in progress, including the reconstruction of ten 5-ton army trucks of those alloted by the Federal Government to the State Highway Commission at Albany and by them turned over to New York City. Some of the more delicate parts of these trucks have to be renewed, dump bodies have to be substituted for the original platform bodies, and in some cases, changes made in the frames; all of which it is estimated can be accomplished for about $700 each, as compared with $5000 which would be the cost of a new truck of the same capacity. The platform beams have been cut off at the rear end by an oxy-acetylene flame to provide for the dumping arrangement, and the old wooden boxes have been reinforced with angle irons on the bottoms, insulated with ¾-inch asbestos board covered with steel plates at an expense of about $200, as compared with $600 for the standard steel boxes manufactured by the truck makers for conveying hot asphalt.

The reinforced boxes will not of course be as durable as the builders' boxes, but will probably last two or three years and, when equipped with

the power dumping hoists that have been provided, will prove efficient and convenient.

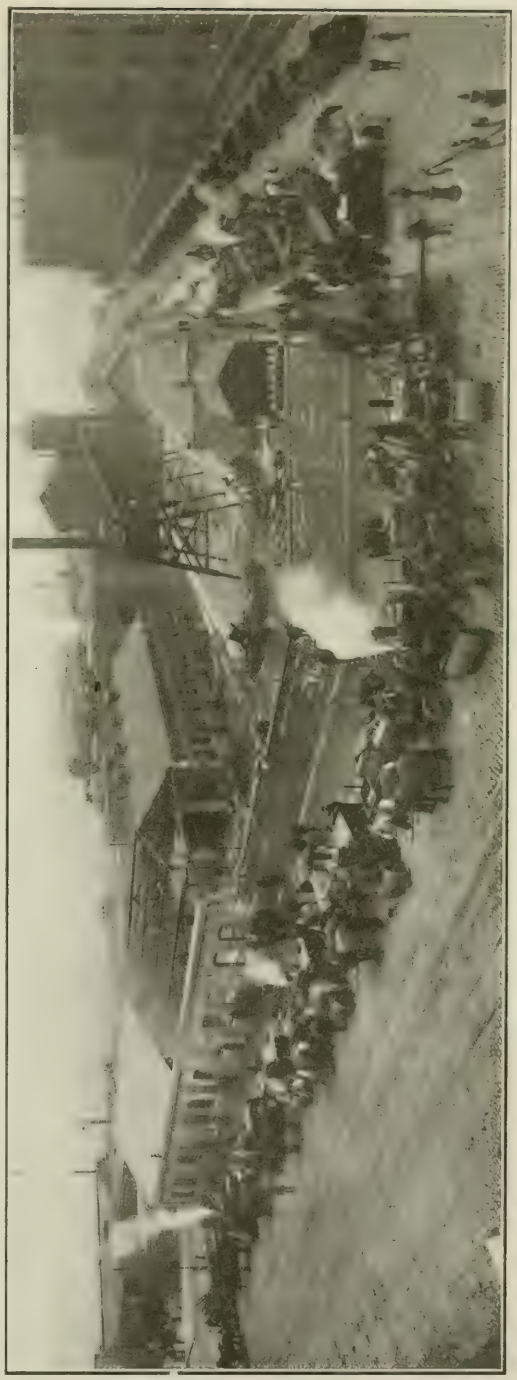
Among the miscellaneous improvements that have been completed recently is the construction of an oil separator in the garage floor to prevent the discharge of waste oil from the floor into the sewer. Among those contemplated in the near future are the enlargement of the binder stone storage bin by extending its concrete walls; the construction of an enlarged stone dust storage building; the construction of a reclamation plant to save a large per cent of the asphalt in condemned pavement that is now abandoned, and to procure from the broken concrete a substitute for stone dust. It is estimated that this plant will cost about $22,000 and will effect a saving of $12,000 per year.

Plans are under way to take care of the dust created in the plant by the installation of a dust collecting system operated by a 25 h.p. motor. When this work has been completed the plant will be 100 per cent dustless and the dust which now goes to waste will be returned to the sand elevators and used in the manufacture of the asphalt. This induction system will also assist the forced draught now used under the fires of the dryers and will increase the output of the plant.

Efforts are being made to provide some system of standardization for the equipment, especially for trucks, of which there are several sizes and types, necessitating a large amount of spare parts kept in stock which would be greatly reduced if fewer makes and sizes were maintained. The purchase of a certain type of truck has been discontinued and eight of those on hand have been scrapped. Instead of selling them for little or nothing, they have been disassembled and all of the good parts carefully inspected, sorted out, and stored to use for spare parts for the remaining 10 trucks of the same type. A store room has been established in which all spare parts, supplies, accessories and tools are kept in charge of a storekeeper, who issues them only on signed requisitions, maintains an accurate inventory and records, and will permit no workman to help himself to supplies, thus materially reducing the temptation to demand certain articles because they are attractive when they are not really needed.

PRINCIPAL EQUIPMENT

The equipment maintained at the plant now includes 26 trucks and trailers for the transportation of hot asphalt binder and finishing course. These comprise 8 five-ton Hurlburts, 1 five-ton Packard, 1 three and one-half-ton Stewart, 7 five-ton Saurers, 1 two and one-half-ton Dodges, 7 two and one-half-ton Republic; also 1 one and one-half-ton Autocar, manned by a chauffeur and two men used for emergency, such as cave-ins and dangerous breaks in pavement, thereby eliminating the movement of an entire gang in such cases.



NOTE: The illustration shows the Manhattan asphalt plant and storage yard. The garage is shown with the roof not yet completed. In the background is the mixing house with the elevated liquid asphalt tank adjacent. The horse-drawn trucks shown have been replaced with motor trucks.

There are sixteen Iroquois, Good Roads, and Kelly-Springfield steam rollers of 5, 8, and 12-ton sizes, and thirty-four 5-ton Watson and Woonsocket 2½-ton trailers. There are five Lutz asphalt heaters, each of the capacity for about 1600 square yards daily. These heaters are usually sent out on the work in the spring, remain outside during the entire season and return to the yards only for repairs or for the winter storage.

Besides serving the asphalt requirements, a part of the yard is used by the Department of Sewers, and affords storage for some of its automobiles and trucks, for concrete materials, and for brick and various sizes of tile pipes, castings, and other supplies.

The plant is under the supervision of chief engineer C. M. Pinckney and principal assistant engineer E. F. Raleigh. It is the direct charge of superintendent Charles J. G. Doherty, who is executing the improvements described, and has planned many of them. Jas. B. Reilly is foreman in direct charge of operation of plant and transportation.

Notes on English Sewage Treatment

During July to September, 1919, Thorndike Saville visited England and France on a Sheldon Traveling Fellowship in Engineering provided by Harvard University. Special attention was given by him to sewerage and river control and regulation. The following notes represent the more interesting of the data concerning sewage treatment in England as contained in his report covering these investigations.

The disposal of the sewage of the northern part of Liverpool by broad irrigation was said by Alexander Brodie, city engineer, to be economically satisfactory but decidedly objectionable from a sanitary standpoint, the effluent being highly putrescible and polluting badly the small stream into which it discharged. There is now on foot a scheme to abandon the farm, cut a tunnel 200 feet along through a hill and connect with the Liverpool main sewers which discharge into the Mersey river. This river is one-half mile wide at the point of discharge, with a tidal ebb and flow at a rate of three or four knots. The original sewage farm cost $750,000. The new project will cost about $500,000 and was the one originally advocated, but the Local Government Board decided in favor of sewage farms.

GREASE EXTRACTION

Bradford.—The sewage of Bradford contains a very large amount of wool grease and dye stuffs, and the chemical composition varies greatly from day to day. The wool grease prevented successful sedimentation, and for a number of years the sewage was treated by precipitating the sludge by the addition of sulphuric acid. Sludge is delivered to the Esholt works, containing 85 per cent of water and 30 to 35 per cent grease. It is screened and run into tanks, where enough sulphuric acid is added to keep it neutral. In these tanks the sludge is boiled with live steam to liquify the grease and aid in its separation. From the heating tanks the sludge passes to closed vessels, from which it is forced by compressed air to the filter presses.

The presses are of the usual type, with cotton filter cloths. There are 128 presses filling a room 150 feet by 300 feet. The cake from the presses contains 20 to 25 per cent of water and 15 to 20 per cent of grease. No attempt is made at present to extract the grease, the cakes being drained and sold for fertilizer, as it contains some 2 per cent of nitrogen. The liquid from the presses is conveyed to a cast iron separating vat, from which the grease, as it accumulates, is run off and pumped to the grease purifying vats. These are 16 in number, of steel, lined with lead. Here the grease is boiled with sulphuric acid and at times with other chemicals. After boiling, the vats stand for 24 hours, after which the grease is withdrawn and packed in barrels or tank cars. A solvent process is to be installed similar to that at Huddersfield, described below, which will extract the grease remaining in the cake.

The effluent from the precipation tanks is conveyed to sand filters or for surface irrigation. There are some 400 acres available for this purpose. The entire plant is designed to treat 30 million gallons per day, with additional provision for the settlement of 12 million gallons of excess storm water.

At Frizinghall, where precipitation of the sludge occurs, there was originally a set of sulphur burners at a gas plant. These burned the spent oxide from the gas works, which contained 50 per cent of sulphur. This SO_2 gas was first admitted to the sewage through a grid of perforated pipes at the bottom of the tank. Later it was mixed by admitting it directly by means of baffle walls, the flow of SO_2 being directed in opposition to the flow of sewage. The gas remaining was passed into a tower down which the sewage trickled. It was thought that by this double process a very thorough admixture and dissolving of the gas would be obtained. The entire process was abandoned, however, because it was found that the sewage would not absorb enough SO_2 to get a proper precipitate. The use of H_2SO_4 was found less costly, owing to the ability to get a more intimate mixture and consequently less volume of acid was needed. Bradford sewage has an alkalinity of 40, but the failure of the SO_2 process

here is of interest, owing to its similarity to the Miles-acid process. This plant made some $500,000 during 1918.

Huddersfield.—The Huddersfield sewage works were distinctly the cleanest appearing and the most odorless of any of the plants visited by Mr. Saville. The sewage goes through coarse screens, then to detritus tanks, which are cleaned by a large bucket on a traveling crane. From these the sewage passes to sedimentation basins. The effluent goes to rotary sprinkling filters and the sludge is pumped to elevated tanks.

In these tanks the sludge is treated with 80 per cent sulphuric acid and is agitated by air blown through it. The wet sludge as it leaves the tanks contains 90 per cent water and 3 per cent grease. This gives a grease content of 30 per cent of the perfectly dry solid matter of the sludge. Cold pressing reduces the water content to 50 per cent after 12 to 24 hours in the presses, the grease content then being 15 per cent. From the presses the sludge cake is carried on a conveyor to granulators and thence to a Ruggles rotary dryer, where it is dried to 15 per cent moisture, giving a grease content of 25.5 per cent. After this, the sludge is elevated to the extraction tanks, where benzine is applied in the solvent process, which reduces the grease to 5 per cent of the dry solid matter, the material then containing about 12 per cent moisture. The resulting cake is sold for fertilizer as it contains 3.5 per cent nitrogen. The grease recovered in 1919 sold for $175 a ton.

Morley.—The plant at Morley, like those at Bradford and Huddersfield, treats the wool waste sewage by the sulphuric acid solvent process. It is a recently constructed plant and contains the best features of the two other plants. Originally the sewage was treated with lime, settled, and the effluent passed into filters while the sludge went to drying lagoons. This has been abandoned and 80 per cent H_2SO_4 is now used as a precipitant. Acid was found to be the cheaper, in addition to rendering the grease content available. Moreover, the quantity of sludge was reduced to 25 per cent, while the total amount of grease in the smaller volume of sludge was greater. The precipitated sludge is fed into sludge boiling tanks, heated by blowing live steam into them for four hours, the steam acting also as an agitator. A narrow-gage track runs beneath the presses and the pressed sludge cake falls into small cars and is rolled to a dump. The grease and water are conducted to a settling tank, where the grease is trapped and runs into settling tanks. From there it goes to a grease ram and thence to refining tanks, where the grease is refined by raising it to the boiling point by a steam coil and spraying with cold water, adding 2 or 3 per cent of sulphuric acid if necessary and mixing for four hours. Five and a half tons of grease per week were extracted and sold at a profit of $700 per week.

The pressed cake for a time was used, after air drying, as fuel for the boilers, mixed with coal. Later a benzine solvent process was installed and run at a profit of $940 a week. The original sludge contained 30 to 48 per cent of grease when dried. The final cake from the solvent process contains 4 per cent grease and is used as a fertilizer.

It should be pointed out that the plants at Bradford, Huddersfield and Morley treat a sewage containing a high proportion to wool waste and that the grease content rarely falls below 30 per cent of the dried sludge. The operators are unanimous in concluding that such plants can be operated at a profit only when the dried sludge contains at least 15 per cent grease, and even then only under prevailing prices of grease. The Morley plant has been the most profitable and satisfactory of all similar disposal plants in England. Mr. Saville quotes Alexander Brodie as expressing the opinion that these plants will do well to clear operating expenses with the decline from war prices for grease, and as being very sceptical of the Mills-acid process when applied to a city installation.

ACTIVATED SLUDGE

Mr. Saville visited Dr. Arden of the Rivers Committee at Manchester, whom he found to be very well informed concerning American experiences in activated sludge and who has operated two experimental plants using this method, one at Witthington, where the sewage is weak domestic, and the other at Davyhulme, where there is a strong sewage containing trade wastes.

The operation of the latter was seriously interfered with by the trade wastes incidental to the manufacture of explosives and it was necessary to curtail the discharge of certain wastes to the sewers and to increase the aeration period of the tanks. In general, however, both experimental plants worked well.

An especially novel feature of the Davyhulme plant is a mechanical arrangement of valves such as to provide intermittent admission of air for aeration. The usual arrangement is for application of air for five seconds, with rest of ten seconds. A working pressure of four to five pounds is used and the air consumption at best, in the previous experimental works, was about 1.28 cubic feet per gallon of sewage treated. A new plant just constructed was expected to take 1.5 cubic feet of air per gallon at 3¼ pounds per square inch.

Dr. Arden was very optimistic regarding the use of the effluent and sludge for agricultural purposes. Certain experiments at Wolverhampton, where a somewhat similar plant is in operation, seem to justify this conclusion. Neither centrifugal nor steam presses have served to effectively dry the sludge. It is suggested that some sort of electric centrifuge may eventually be devised making use of a charged electrode to rupture the charged colloidal particles of centrifuged sludge.

Bradford.—Some experiments had been made with activated sludge at Bradford, but it was found that with this sewage the process was too susceptible to temperature changes. If a cold snap occurred the precipitated sludge became deflocculated. Also, the problem of de-watering the sludge was a determining influence, as this would

have entailed prohibitive expense when treating 400 to 500 tons of sludge per day.

Sheffield.—At Sheffield were being conducted the most novel and startling experiments on activated sludge that Mr. Saville had heard of. The plant at first consisted of two tanks each holding about 1,200 gallons, equipped with revolving paddles set horizontally. These were originally designed to suck air in through a tube by creating a vacuum. It was found, however, that no air was required. Sufficient sewage is admitted and the paddle rotated for eight hours, when the sewage is allowed to settle for one hour, and an absolutely clear, odorless and stable effluent is drawn off. If samples of fresh and activated sewage are placed in bottles, the former remains black with suspended matter for days, while the latter clears in half an hour, leaving an odorless and colorless liquor that remains stable for over a week. There was a large experimental plant operating in which the paddles were vertical, two sets rotating together. In this way about 10,000 gallons per day were treated. The fresh sewage was passed through grit chambers, where it remained for half an hour or so and then flowed directly to the activation chambers. The sludge was drawn off not more than once a month. Nothing had yet been done toward de-watering the sludge. This process seems to possess all the good results of the ordinary method with no air pipes or diffusers to bother with.

OTHER METHODS

At Manchester the old works consist of coarse screens, sedimentation basins and 110 acres of contact beds. The latter were badly overgrown from neglect due to the shortage of labor during the war, and were being cleaned.

At Carlisle some 300,000 gallons per day were treated on four acres of sprinkling filters, about 1.5 acres being used at a time. The spraying device consisted of ½-inch perforations in the 3-inch distribution pipes, there being circular splash plates one inch in diameter for each hole. The settled sludge was flushed onto beds, dried and sold to farms. The entering sewage was screened and then pumped to sedimentation tanks, from which the effluent went to the sprinkling filter.

At Birmingham an interesting scheme was being tried using two-compartment septic tanks, the tanks being separated from each other and on the same level instead of the vertical arrangement of the Imhoff tank. The sewage flows first through the detritus tank equipped with a hydraulically operated dredge. Then it flows through fine sedimentation tanks in parallel, then through a balancing tank, and then to the stream. The sludge is pumped from the sedimentation tanks about once a week to digestion tanks, which are really lagoons. The sludge contains 92½ per cent water. The dried sludge is quite odorless.

A Concrete Job Mechanical*

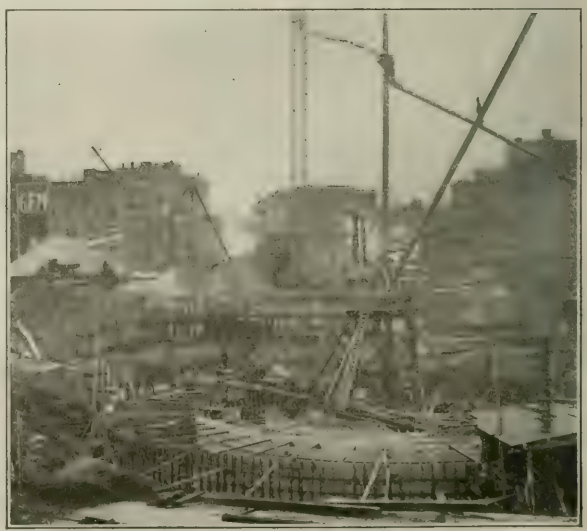
Handling the concrete aggregates. Forms for foundation walls. Reinforcement steel.

HANDLING MATERIALS

For the sub-structure contract there are required about 17,000 yards of 1-inch broken stone from the Calvin Tompkins quarries at Tompkins Cove, on the Hudson river, 9,000 yards of sand from Cow Bay, Long Island, and 114,000 bags of Portland cement of the Pennsylvania Cement Co.'s brand. All of which are delivered by the contractor's fleet of about 50 Pierce-Arrow motor trucks.

The cement is hauled about half a mile from the dock to the cement storage shed, which has a capacity of 30,000 bags. From here it is loaded by hand into a 1-yard steel bucket hoisted in a steel tower about 40 feet high to the charging platform of the concrete mixer, where the bags are opened and emptied by hand into the charging hopper and the empty bags dropped through a chute in the floor to the bag house, where they are cleaned by a hand-operated Century cement bag shaker that recovers 2 or 3 bags of cement from every

*Concluded from page 8.

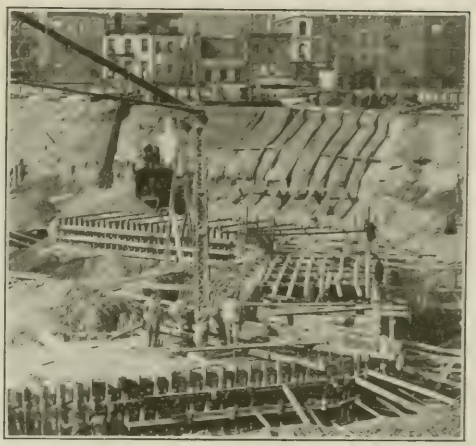


PAIRS OF CURVED REINFORCEMENT BARS USED AS RANGERS ON CONCRETE FORMS

100 empty bags. The empty bags are placed in a Rowe baling machine, which folds and compresses them and holds them while they are securely wired in lots of 50. This arrangement insures a considerable economy in saving cement and bags and in preparing the bags for transportation so that none can be lost, damaged or withdrawn from the package in transit.

Sand and broken stone are delivered at the pier at the foot of Jefferson street, East river, on barges of 500 to 600 yards capacity, which are unloaded by a 1-yard clam-shell bucket operated by a derrick and hoisting engine which deliver to an elevated hopper bin of 15 yards capacity which is used alternately for stone and sand. The bottom of the bin is about 8 feet above the deck of the pier, with clearance under it for the motor trucks that are spotted there while the operator opens both of the two gates and fills the trucks in about 1 minute. Each truck averages from 20 to 22 round trips in one 8-hour shift.

At the court house the trucks are backed up a plank paved inclined fill against a timber sill over which they dump at the edge of the storage pile, the lower portion of which is partly confined by wooden bulkhead walls. A 1½-yard clam-shell bucket operated by a 60-foot derrick boom reclaims the stone and sand dumped from the trucks and constantly keeps filled the small bins in the concrete tower. When not employed in this service it reclaims the sand and stone dumped at the foot of the storage and trims them up in tall piles, always forming a large reserve stock for use if the delivery of the barges is interrupted. The



FORM FOR OCTAGONAL FOUNDATION RING; INCLINED SKIDS FOR SLIDING REINFORCEMENT BARS FROM STREET TO EXCAVATION

POURING CONCRETE IN OUTER RING FORMS FROM DUPLEX REVOLVING SPOUTS.

stone and sand are drawn through bottom gates in the elevated bins to the charging hopper, so that the mixer can be operated at maximum speed. Large steam coils are installed on the ground under the bottoms of the storage piles so that in cold weather the entire piles can be heated and keep the aggregate at a suitable temperature for mixing whenever the temperature is high enough to permit the concrete work to be carried on. Provisions are also made for heating the concrete mixing water with live steam if necessary.

CONCRETE FORMS

The foundation walls are built successively and each ring is built in successive sections in wooden forms made up of panels about 20 feet long and 7 feet high, built on carpenters' benches adjacent to the work and put in position by hand. They are of very simple construction, made of 1-inch tongue-and-grooved boards. The larger pieces are built first and are stripped after the concrete is from 24 to 36 hours old, thoroughly scraped, and reassembled for the next section, and so on, thus using them from 3 to 5 times each. A force of carpenters are continually occupied in building, setting, stripping and cleaning the forms.

The form panels are set against vertical outside posts usually made of 3 x 6-inch timber, spaced about 4 feet apart. These timbers are connected by plain horizontal ½-inch round rods 2 feet apart vertically that pass transversely through the forms and are permanently left there. They are made of ample length and project beyond the faces of the verticals, where they pass through "Universal clamps" provided with set screws. These clamps are adjusted to the right position which determines the width of the forms, after which operation the set screws are screwed up tightly, holding the panels in position against internal pressure and obviating the necessity of cutting threads on the ends of the rods. The rods are heavy enough to resist considerable pressure from the wet concrete and stiff enough not to unduly sag in the long span between the sides of the form, and also serve to support and hold in position any of the reinforcement bars which are wired to them.

When the forms are to be stripped it is only necessary to loosen the set screws, remove the clamps, and take off the verticals and panels, leaving the ½-inch rods projecting several inches beyond the face of the concrete. These projections are then cut off flush with the surface of the concrete, leaving no holes to be pointed and no steel outside the concrete.

REINFORCEMENT STEEL

Notwithstanding their massive character, their abundant bearing surface, and the excellent quality of the sand on which they are seated, the foundation walls are reinforced with a very large amount of reinforcement bars up to 1-inch square, and usually in 38-foot lengths as received from the mill. Near the bottom of the wall there are four tiers of rods about 4 to 6 inches apart, two tiers being transverse under column bearings and two tiers longitudinal. The bottom tier rods are supported on concrete blocks manufactured at the site and are wired together at intersections, forming a complete, independent framework, put in position before the concreting is commenced. In the upper part of the wall there are two tiers of horizontal rods corresponding to those in the bottom, and suspended by wire rope loops from transverse caps reaching across the forms from side to side.

The reinforcement bars are delivered by motor trucks and skidded to the bottom of the excavation on four lines of inclined timbers on the slope of the pit, and at the bottom are assorted, stored, cut to length and bent as required. The longitudinal rods in the curved rings are all bent to the required radius in a motor driven 3-roll bender at the rate of 80 bars per hour, by a gang of 6 men supplying and taking away the bars from the machine.

These curved bars have been utilized for outside waling pieces on the forms, pairs of bars being set at top, bottom and intermediate points of the verticals, and wired in position, thus saving a considerable amount of timber and the work of cutting it to the proper curvature, as well as presenting a neater appearance, being more convenient, and without at all injuring the steel for its final use as reinforcement in the concrete.

The spacers used to separate the bottom tiers of reinforcement rods and keep them above the bottom of the forms have a uniform thickness of 3 inches and are made of 1:2 cement mortar cast in slabs about 6 feet wide and 10 feet long on wooden platforms with removable side pieces

SPOUTING CONCRETE FROM CHUTES ON COUNTERWEIGHTED REVOLVING TRUSSES

3 inches high on each of the four sides. These pieces are clamped in position and the space between them is filled with mortar, screeded off to the level of the tops of the side strips. As soon as the mortar is sufficiently set a straightedge is laid across, connecting corresponding marks on opposite sides, and serves as a guide for a thin-bladed scoring tool which cuts through the full thickness of the slabs, dividing the concrete into strips 3 inches wide and about 18 inches long. After these have set from 12 to 24 hours, the side pieces are removed and the small pieces are detached if necessary by again cutting through the joints with the scoring tool. They are then ready for placing in the forms, where they make an integral part of the monolithic mass, thus providing for the accurate positioning of the steel without introducing any foreign or objectionable element into the concrete. The blocks are made by 3 men who can readily turn out 2,000 in one 8-hour shift.

Guy Lowell, the architect, is represented by a well-organized staff, including Major John H. House, Jr., in general charge; Wm. B. Claflin, superintendent of construction; E. W. Jacobus, clerk of the works, and Harry W. Andrews, designing engineer of structural steel. Moran, Maurice & Proctor are consulting engineers for the foundations.

On December 1, Rodgers & Hagerty, Inc., had completed about 70 per cent of the contract and work is being vigorously prosecuted by an average force of 200 men under the direction of field superintendent Henry Stone and managing field engineer, Walter Caccia. James J. Kelly, of this organization, is in charge of the surveying parties required for the work.

Duluth's Water Scare

A report made public in Duluth by the Academy of Clinical Medicine of that city some days ago notified the city that the drinking water was shown to be unsafe by tests made by Dr. J. A. Cancik, bacteriologist of the academy and who was formerly connected with the water inspection department of the University of Prague. In view of the importance of the subject, the St. Louis County Medical Association called a special meeting at which this report and the analyses of Dr. Cancik were severely criticized. This society stated that the Academy of Clinical Medicine had thrown the whole city into a turmoil of fear on the basis of what it acknowledged to be only a preliminary report based upon a single unsupported analysis which did not show the presence of any B coli, but only a considerable number of miscellaneous bacteria.

On the other hand, the division of sanitation of the state board of health reports that Duluth's water supply has been consistently safe, with a bacterial count generally less than 10 (Dr. Cancik claimed to have found more than 1,400). During the year 1920 there have been 33 cases of typhoid, which was the same number as in 1919; and about 75 per cent of these have been shown to be out-of-town cases, while most of the others were caused by drinking well water, or other causes aside from the public water supply. Moreover, there had been only 16 deaths from diarrheal complaints among children this year as against 19 last year, while the last 2 months have shown no deaths at all from this cause.

The medical association adopted a report tended to allay the public apprehension, stating that the public is entirely safe in drinking the present water. In view of the importance of the matter it recommended that co-ordinate analyses be made between recognized state health authorities and Dr. Cancik.

Solving a New Jersey Water Problem

Three companies supplying twenty-nine communities pool their supplies and propose novel plan for financing additional supply.

Three water companies of New Jersey supply water to 29 cities and towns in the counties of Union, Middlesex and Summerset. These companies obtain water from 13 sources and many of the mains are interconnected so that the companies aid each other in making full use of all of these sources, which are now taxed to their capacity; so much so, in fact, that should a long dry or cold spell occur there would probably be a shortage in this part of the state. As the towns are increasing in population at the rate of about 8,000 a year, it seems to be imperative that an addition to the supply should be obtained. The several companies are acting in unison in the matter and have prepared plans for obtaining an additional supply at the junction of the Millstone and Raritan rivers, about three miles southwest of Bound Brook, plans for developing this source having been made by Morris R. Sherrerd and Allen Hazen and approved by the Board of Conservation and Development of the state.

The companies, however, find themselves unable to raise the necessary funds for carrying out the extension owing to present financial conditions. The combined capitalization of all the companies is a little over $4,000,000 and the cost of developing this supply and of making needed extensions of the distributing mains was estimated at $3,000,000 about a year and a half ago. The companies apparently are anxious to do what they can to bring the supply and the system up to the requirements and are willing to adopt any reasonable plan to this end. They see only three alternatives for obtaining the needed capital: to sell the water works to the towns at a price to be fixed by agreement, by arbitration or by proceedings in condemnation, as the towns may prefer; or second, by sale of

the distribution mains in each of the towns, the companies retaining their trunk mains and the present sources of supply, selling the water to the towns and using the money derived from the sale of the distribution mains for developing the additional supply; or third, by a contract between the towns and the companies which would enable the companies to raise the necessary money.

They suggest as a favorable solution the conveying of the property at the junction of the Millstone and Raritan rivers (where they have purchased about 200 acres of land in the name of one of the companies) to a new corporation which would be organized for the purpose of constructing dams at this point, pumping and sedimentation basins, supply mains, filtration and sterilization plants and reservoirs, the new company to issue 30-year 7 per cent bonds to the amount of $10,000,000, the bonds to be secured by a mortgage on the property of the company and guaranteed by the several existing water companies; the bonds to be issued in the necessary amounts from time to time and offered to the inhabitants of the municipalities which are served by the water companies in question.

"In order to provide security for the principle of said bonds and for payment of the interest that shall accrue thereon, and to enable the said companies to obtain, from time to time, additional capital necessary to maintain and extend their system of water works, rates for water charged by the Elizabethtown, Plainfield-Union and Middlesex water companies and their successors shall be prescribed and fixed for a term of 30 years by a board to consist of three members—one, an engineer to be appointed by the water companies mentioned in this paragraph or their successors; another, an engineer to be appointed by a committee nominated by the governing bodies of the municipalities, or their successors, supplied with water by said companies, or by the governing bodies of such municipalities having a majority, by the last census, of the inhabitants of all of such municipalities; and the third member of the board to be appointed by these two engineers. The decision in writing signed by any two members of such board shall be binding. During the period of 30 years after rates shall be so fixed the same shall be subject to revision at any time, for the purpose aforesaid, exclusively and in the same manner by a similar board or any two members thereof, to be appointed as stated above," if any water company or municipality asks their revision. A contract embodying the above would be entered into between the governing bodies of the municipalities and the water companies, which contract would not restrict the right of any municipality to acquire the property of the water companies by purchase or condemnation.

This plan is described, as well as the conditions which seem to make something of the kind necessary, by a statement issued jointly by the water companies. This statement also asserts that legislation would be necessary for carrying out this plan. It offers to the towns interested every opportunity for investigating the financial and physical conditions of the companies. A circular was sent on December 16 to the 29 municipalities served. There is yet no public indication as to how it will be received by them.

Viaduct for Bethlehem

Plans have been completed by the bridge engineer employed by Bethlehem, Pa., Clarence W. Hudson, for a viaduct or bridge across the valley, with its railroads, which lies between Bethlehem and West Bethlehem. The bridge will be connected with streets by means of 8 ramps and the total length is something over 6,000 feet. The bridge proper will have a width of 64 feet. Facilities are afforded for island platforms for connecting the Lehigh Valley, Reading and Central Railroad tracks with the bridge by means of inclined planes and stairways. There will be 11 reinforced concrete arch spans of varying lengths and two steel spans over the railroads. The plan originally proposed was of the spandrel arch type, but calculations showed that the cost could be reduced by substituting the filled arch type, and the latter was adopted. Considerable thought has been given to other changes looking to reducing the cost to a minimum consistent with absolute safety and serviceability.

Power from Colorado River

Application has been accepted by the Federal Power Commission for a preliminary permit to develop 2½ million horse power from the Colorado river, the application being that of the Southern California Edison Co., which plans to distribute current through California, Utah, Arizona, Nevada and Colorado. There will be a storage basin more than 200 miles long impounding more than 40 million acres-feet of water. Incidentally, the damming of the river would tend to eliminate its seasonal floods. The total possible hydroelectric development of the river is calculated at more than 4 million horse power.

Government Aid for British Roads

The British Ministry of Transport has offered to contribute 50 per cent of the cost of constructing roads and streets in British cities, and in addition to loan to the municipalities the remaining 50 per cent for five years, repayable in annual installments. Ex-service men receive preference among applicants for employment on the road work, but all applicants are required first to submit to one week's registration at the established labor exchanges, in order to eliminate floating labor. So far work amounting to more than $7,000,000 has been undertaken by the cities of Bristol, Liverpool, Dundee, Manchester, Aberdeen and ten other cities, while 8 additional ones are considering similar unemployment schemes requiring expenditures of about $2,500,000.

PUBLIC WORKS

Published Weekly
by
Municipal Journal and Engineer, Inc.
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates

United States and Possessions, Mexico and Cuba....$3.00 per year
All other countries .....$4.00 per year

Change of Address

Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

CONTENTS

MANHATTAN BOROUGH ASPHALT PLANT—Illustrated 21
NOTES ON ENGLISH SEWAGE TREATMENT.. 24
A CONCRETE JOB MECHANICAL—Illustrated.... 26
Duluth's Water Scare 29
SOLVING A NEW JERSEY WATER PROBLEM.. 29
Viaduct for Bethlehem 30
Power from Colorado River 30
Government Aid for British Roads 30
EDITORIAL NOTES 31
Snow Fighting in City and Country—Elements of an Attractive Contract—More Immigrants Needed.
SOME 1920 CENSUS FIGURES 33
Creates Park to Save Tree 34
SIMPLIFYING ZONING—Illustrated 35
REMOVING SNOW FROM CITY STREETS..... 37
A 117-Mile Section of Concrete Highway Completed... 40
HOW CAN CONCRETE SHEET PILES BE INSTALLED?—Illustrated 41
IMMIGRATION NOTES 43
RECENT LEGAL DECISIONS 44

Snow Fighting in City and Country

A few years ago only the largest cities thought it necessary to remove snow from their streets, and then only from the principal thoroughfares. With the increase of motor traffic and especially of motor truck traffic, however, the importance of uninterruption in the transportation of goods has become so vital that not only all of the main traffic streets in every city of size or importance, but even the main highways through the country districts,, must be kept open during the winter if embarrassment to business and financial loss to merchants is to be avoided.

In this issue we present the latest ideas in connection with the removal of snow from city streets. Next week we expect to supplement this with another article dealing with keeping open the main highways of the country during the winter season, with special reference to the practices of the several state highway departments.

Elements of an Attractive Contract

The absolutely imperative requirements for every contract should be honesty and fairness in letter and in spirit. If in addition there is open-mindedness, consideration and prompt and efficient fulfilment of all obligations on the part of the owner and engineer, the contract should be acceptable to any good and competent contractor who desires to execute this class of work. Usually the work may be expedited, the cost reduced, the duties of the engineers and inspectors made easier and simpler, the owner better served, and the contract made much more desirable to the contractor, even to the point of justifying a lower bid, if, in writing the contract and specifications and in carrying out the agreement, special attention be paid to a number of features that are often the cause of difficulty or unfair conditions and treatment.

The contractor should never be held responsible for the design or for the maintenance and operation of the work. The work should be kept entirely free from political influence. The drawings, specifications and contract should be clear, concise, positive and exact, and should contain no contradictions or ambiguity. Nothing in them should be capable of contradictory interpretation. Classifications should be made thoroughly and carefully.

The necessary drawings should be furnished well in advance of the time that they are required for use. All changes should immediately be specifically covered by full descriptions, drawings and written orders. All designs, specifications and schedules should be co-ordinated to permit the work to be executed in the most advantageous sequence, without delay or interference and at the most seasonable times.

Unnecessary precision in the execution, and too minute accuracy should be avoided. The use of standard methods, operations, materials and plant should be promoted. Standard sizes and commercial articles should be used to the exclusion of special ones when practicable. The use of local resources should be permitted where available. Unnecessary refinements should be eliminated. Materials and workmanship should be suited to the reasonable requirements, thus permitting second class to be advantageously used where first class is not necessary.

Very elaborate or extensive work can often be classified for more advantageous construction under several separate contracts. Where very large quantities of materials or supplies are required they may often be advantageously furnished to the contractor by the owner, thus insuring quality and delivery, and eliminating profits on market prices. Plant and equipment necessary for several contractors may often be advantageously furnished by the owner, as in the case of his building a service road to supply a long line of construction, furnishing power from a central plant, or developing aggregate for concrete. If the survey or investigation of local conditions is difficult,

costly or prolonged, it should be made by the owner's engineers and supplied to all of the invited bidders, thus elinimating duplication of costs.

Estimated quantities and specific data should be guaranteed in many cases, with specific provision for their increase or decrease. Provision should be made for necessarily unbalanced bids and for important increase or decrease of quantities when such changes may seriously affect the contractor.

In a unit price contract, automatic changes should be provided for important items subject to great fluctuation. Responsibility for damages should be very clearly stated. Penalty clauses should be balanced by bonus clauses. Elements of uncertainty not dependent on the contractors' skill or resources should be assumed, as much as possible, by the owner, thus removing unnecessary risks to the contractor.

If the contract is not a lump sum or unit price agreement, great care should be given to provide in advance for a fair settlement for differences of payment corresponding to changes in design or quantity. Good results will often be obtained by providing for the contractor to share a certain proportion of any saving in the execution of the work. Controversies should be settled by a third party and solely on their merits. The retained percentage should be reduced as the work nears completion. Moderate surety bonds should be required. Open shop work should be insisted on.

More Immigrants Needed

The terror of European immigrants to this country which has been carefully nursed and the frantic demand for the absolute prohibition of immigration or for drastic laws controlling it are founded neither on facts nor on a basis of reasonable probabilities. They are largely dangerous propaganda of professional agitators of the labor unions that aim to absolutely monopolize labor as a class trust and to continue dictatorship of the same quality defined by the Adamson law and the Plumb railroad bill. It is their policy to create by any means the utmost scarcity of labor so as to enforce their extortionate demands for high wages and inefficient services. To do this they have skilfully inspired a vast amount of hysterical and irresponsible newspaper statements, and are exerting every possible ounce of political pressure.

The important facts that require neither argument or proof, are that all necessities and commodities in the United States have been greatly depleted by the war during the last six years, that normal production and industry of every sort have been reduced and have not yet regained standard conditions, so that we have not only failed to make up any considerable part of the great deficits, but, as we are not yet functioning up to the average, are still falling farther and farther behind. Production and improvement are still losing ground and high prices and unsafe conditions continue.

At no time has there ever been a serious or Previous to the war there was a steady and constantly increasing immigration of over 1,000,000 per year that supplemented the necessary supply of labor and was relied upon and necessary. The cessation of this supply and the further loss of hundreds of thousands of emigrants from this country during the war has seriously diminished the never excessive amount of labor available until now there is far less than enough for normal requirements while we are confronted with much more than normal necessities to regain our position to say nothing of the tremendous increase that we should have to conduct the unprecedented export business that awaits and almost demands development.

There is no labor surplus in this country to-day. The very small amount of local unemployment is due to business depression and the reaction from extravagance and chiefly to the inefficiency of labor itself that cannot forever compel capital to pay several times the real value of services. The moment that improvements and general construction are resumed in anything like the necessary degree, there will be great and dangerous shortage of labor. If it is not relieved, great loss and still more dangerous and unsettled conditions will result.

The trouble can be relieved only by admitting large numbers of selected immigrants; no matter how much they are encouraged, they will be needed before they can arrive, and any present diminution of the supply is a serious injury to the country.

We now have the choice of the sturdy and most valuable workers of the world in large quantities. It only remains to select the most desirable ones and distribute them where they should go and to exclude the undesirable ones. We principally need unskilled labor who will in nowise lower the standard of living or compete with efficient skilled labor, or according to high authority, materially lower wages. On the contrary, their presence will make for more work for skilled employees and mechanics. Abundant facilities should be organized for inspecting, selecting and directing them at points of embarkation; a supplementary organization should be provided at Ellis Island, and those accepted should be classified, distributed and rapidly and systematically Americanized. The literacy test which excludes many capable workers and never excludes the radicals and agitators should be abolished and more stringent means taken to detect and exclude Bolshevists and their class.

A large proportion of the present increase of immigration that is causing so much needless alarm is composed of dependants that will not affect the labor market but will tend to stabilize the relatives already here who are good workers and are returning to their old jobs.

Congress will do well to consider these facts impartially and, refusing to deprive ourselves of the necessary commodity that is offered us, will devise means to secure and use it most abundantly and advantageously.

Some 1920 Census Figures

Growth of large, medium size and small municipalities during the last decade compared with that of former decades. Some individual instances of phenomenal gains and of losses in population.

Final official figures have not yet been published for the complete population returns as obtained by the 1920 census, but we have obtained through the courtesy of the Census Bureau figures for all cities of 5,000 inhabitants or more, subject to correction before final certification. It is probable that there will be no material changes made in these, and certainly none large enough to in any way alter the general conclusions as to trend of population as shown by them.

CITIES OF 25,000 POPULATION AND LARGER

We first notice that the number of cities of 25,000 population or more has increased from 226 in 1910 to 288 in 1920, an increase of 62. In the previous decade, from 1900 to 1910, the increase was 65—approximately the same.

The increase in population, however, has not been so great. The cities which entered this group between 1900 and 1910 had an average population of about 16,000 at the beginning of the decade, while the cities which entered the group between 1910 and 1920 had an average population of 18,700 at the beginning of that decade. Expressed in another way, the increase in population of all the cities which had a population of 25,000 or more in 1920 was 36.4 per cent in the first decade and 27.6 per cent in the second decade. If we include in the total for each census of 1900, 1910 and 1920 only those cities which at that census had a population of 25,000 or more, we find the increase in population living in cities of 25,000 or more was 44.3 per cent between 1900 and 1910 and 29.0 per cent between 1910 and 1920. In 1900 the population living in cities of this size was about 26.1 per cent of that of the entire country, in 1910 it was 31 per cent, while in 1920 this had increased to 34.7 per cent.

Examining the figures in detail, we find some interesting and curious developments in the growth of certain individual cities. For instance, a number of cities which increased considerably in the decade of 1900 to 1910 lost in population during the decade of 1910 to 1920; while on the other hand, some of the cities which gained in the latter decade had lost in the previous one. For illustration, Pueblo, Colo., gained about 58 per cent in the former decade but lost 3.3 per cent in the latter. Newport, Ky., gained 7.1 per cent in the former but lost 3.3 per cent in the latter decade. Salem, Mass., gained 21.5 per cent in the former decade but lost 2.7 per cent in the latter. Others in the same class are Joplin, Mo.; Hoboken, N. J.; Troy, N. Y.; and Superior, Wis. Manhattan Borough of New York City had gained 26 per cent in the former decade, but lost 2 per cent in the latter, although the city as a whole gained 17.9 per cent in the latter decade.

In the other class we find that Cicero, Ill., after losing 10.7 per cent of its population in the former decade gained 209.1 per cent in the latter. Chelsea, Mass., lost 48 per cent in the former decade, but gained 33.1 per cent in the latter. St. Joseph, Mo., lost 24.8 per cent in the former, but gained 0.7 per cent in the latter, by no means restoring it to its original population. Altogether five cities in the list lost in population during the decade of 1900 to 1910, while nine lost in the decade of 1910 to 1920.

Some illustrations of phenomenal growth are shown in this twenty-year period. Miami, Fla., had a population of 1,681 in 1900, 5,471 in 1910 and 29,549 in 1920. Tampa, Fla., also grew from 15,839 to 51,252 during the two decades. Hamtramck, Mich., did not exist in 1900, had 3,559 in 1910, and had 48,615 in 1920. Highland Park, Mich., increased in the two decades from 428 to 46,499. Irvington, N. J., increased from 5,255 to 25,840. Newark increased from 246,070 to 414,216. West New York, N. J., increased from 5,267 to 29,926. East Cleveland, Ohio, at the three censuses in question had populations of 2,757, 9,179 and 29,292, respectively. Lakewood, Ohio, had populations of 3,353, 15,181 and 41,732. Tulsa, Okla., had populations of 1,390, 18,182 and 72,075, an increase of more than 5000 per cent. Portland, Ore., increased from 90,426 to 258,288. Bethlehem, Pa., increased in the last decade from 12,837 to 50,358, probably due largely to the stimulation of the steel industry because of the war. Knoxville, Tenn., more than doubled in population during the last decade or from 36,436 to 77,818. Wichita Falls, Texas, increased from 8,200 to 40,079 in the last decade. Washington cities increased from 120 per cent to 216 per cent between 1900 and 1910, but during the last decade increased only from a nominal increase of 35 persons in the case of Spokane to a maximum of 33 per cent in the case of Seattle. Clarksburg, W. Va., had populations of 4,050, 9,201 and 27,869 at the three census periods. California probably showed a more remarkable growth between 1900 and 1910 than any other state, Berkeley increasing 206 per cent, Long Beach 691 per cent, Los Angeles 211 per cent, Oakland 124 per cent, Pasadena 232 per cent, San Diego 124 per cent, and all of the others more than 21 per cent. During the last decade, Long Beach was the only one to increase more than 100 per cent, its increase being 212 per cent. San Diego came next with 88.7 per cent, then Los Angeles with 80.7 per cent, Fresno 79.2 per cent, Stockton 73.3 per cent, Pasadena

49.7 per cent, Sacramento 47.3 per cent, Oakland 44.1 per cent, Berkeley 38.2 per cent, San Jose 36.8 per cent, and San Francisco last of the cities of the state, with 21.9, thus falling behind Los Angeles, having a population of 508,410 as compared to 578,673 for the latter city.

PLACES OF 10,000 TO 25,000

Considering the cities of from 10,000 to 25,000 population, we find that there were 264 of these in 1900, 346 in 1910, and 472 in 1920. The total populations of the cities in this class at each of the three censuses was 4,120,678, 5,215,820 and 7,147,329, respectively. This shows an increase of population living in cities of this class of 26.5 per cent between 1900 and 1910, and 37 per cent between 1910 and 1920. In the latter decade the increase in population is due to some extent to the greater number of incorporated places included in the successive censuses. If we take the population of all the places included in the 1920 census, we find that the population of these increased by 37 per cent between 1900 and 1910, and 24.5 per cent between 1910 and 1920. In 1900 the per cent of the total population which lived in cities of this class was 5.4 per cent, in 1910 it was 5.6 per cent and in 1920 it was 6.6 per cent.

In this class also we find certain individual cities losing in population during the 1910-1920 decade, including 1 in Arkansas, 1 in California, 2 in Connecticut, 1 in Florida, 2 in Indiana, 3 in Iowa, 2 in Kansas, 3 in Massachusetts, 5 in Michigan, 1 in Mississippi, 2 in Montana, 1 in New Hampshire, 5 in New York, 2 in Oklahoma, 8 in Pennsylvania, 2 in Rhode Island, 1 in Vermont, 1 in Washington, and 2 in Wisconsin. This shows a total of 45 incorporated places of 10,000 to 25,000 population which lost in population in this decade, while in the previous decade the total number was only 24 for the entire country.

PLACES OF 5,000 TO 10,000 POPULATION

The incorporated places of from 5,000 to 10,000 population numbered 415 in 1900, 551 in 1910 and 746 in 1920. The populations at these three censuses were 2,854,540, 3,829,740 and 5,177,162, respectively. This shows an increase of 34 per cent in the former decade and 35 per cent in the latter decade in people living in incorporated places of this size. If we consider all of the places included in the last census, we find the increase was 36 per cent between 1900 and 1910, and 25 per cent between 1910 and 1920.

Considered in relation to the entire population, we find that in 1900 3.8 per cent of the total population lived in incorporated places of from 5,000 to 10,000 population, 4.2 per cent in 1910 and 4.7 per cent in 1920.

As is natural, we find percentages of increase in the decade considerably greater in the small places of from 5,000 to 10,000 than in the large cities, since a comparatively small number of new residents means a considerably higher percentage of growth. A very considerable number of these small incorporated places in all sections of the country are found to have increased more than 100 per cent, apparently the highest percentage growth being that of Eastland City, Texas, with an increase of 995.7 per cent. This illustrates the previous statement, however, since the actual increase in population was only 8,513. In the cities of this class the largest total decrease in population was that of Webb City, Mo., which lost 4,010 from a population in 1910 of 11,817. The greatest increase in population was that of Eastland City, Texas, the total increase being 8,513, this being also the highest percentage of growth, as previously stated.

The greatest number of incorporated places of from 5,000 to 10,000 population are found in Pennsylvania, there being 93 such places in that state. The next largest number is found in Massachusetts, with Illinois third; while Ohio, Michigan, New Jersey and New York run very close for fourth place. Of places of 25,000 population or more Massachusetts leads with 27, New York follows with 22, New Jersey and Ohio each have 21, and Pennsylvania 20, Illinois has 17, Michigan 14, and Indiana 12. Rhode Island, one of the two smallest states in the Union, contains five cities of more than 25,000 population, six of between 10,000 and 25,000, and eight of between 5,000 and 10,000. Delaware, the other smallest state, contains one city of more than 25,000 population, and no other incorporated place as large as 5,000.

RELATION OF URBAN TO TOTAL POPULATION

Cities of more than 25,000 population contained 26.1 per cent of the entire population of the country in 1900, 30.9 per cent in 1910, and 34.7 per cent in 1920. This shows a slight decrease in the rate of growth of the larger cities as compared to the growth of the entire country, while for the places of the two smaller classes the rate of growth has increased.

Considering all the cities of 5,000 population or more, we find that in 1900 35.1 per cent of the population lived in such places, in 1910 40.7 per cent and in 1920 46.0 per cent. If we consider all incorporated places, of which there are more than 14,000 smaller than 5,000 population, we find a little more than 60 per cent of the population living in these places. This is the population generally referred to in statements on the subject as being urban population. A great many incorporated places of 1,000 or less, and even many of 2,000 or 3,000 population, are living under conditions which would seem to be those of the country rather than of the city; and if we draw the line at about 5,000, we find that less than half of the population of the country has yet moved to places of this size, although if the movement continues at the present rate from country to city, the next census will find somewhat more than 50 per cent of the population living in places of more than 5,000.

Creates Park to Save Tree

At the time of grading Main street in Visalia, Cal., a majestic oak tree was left standing in the street, and, fearing that it might be cut down by some future officials, a small plat of ground about

it was made into a public park surrounded by a concrete curb. This was named Askin park after a former mayor of the city and his wife was appointed the official custodian. This is believed to be the smallest public park in the United States.

Simplifying Zoning

By George B. Ford and E. P. Goodrich*

What zoning should and can secure, its legal limitations. East Orange's recent zoning ordinance.

Following the successful example of New York, already a dozen cities have adopted "zoning ordinances," at least thirty are well advanced, and a hundred more are on the point of starting.

Zoning is the "best seller" among civic improvement ideas to-day, because it gives the city a far-reaching control over the use and development of private property, to the great benefit of the public; all for virtually nothing.

In New York City the increased taxes based on the benefits arising from the zoning law have already paid the cost of drafting the ordinance and maps several times over. Millions are being saved in transit extension because now at last the engineers know exactly the kind and amount of development possible in each section of the city.

St. Louis claims it would have saved two and a half million dollars in the extension of its sewer system had the zoning been in force earlier. Water system extension, paving programs, even fire protection and school programs in New York, St. Louis and Newark are showing marked savings, thanks to a definite plan of growth for the city.

The real protection against a selfish neighbor which zoning affords is already improving the marketability of property in New York. The home-seeker or the business man is less hesitant to build because he can now know what surroundings to count on. He no longer has to fear the erection of a factory or a garage next door nor a four-story apartment, built out on the street line, cutting off his light and air.

Zoning spells orderliness. A place for everything and everything in its place. It is exactly the same principle applied to the city as a whole, that the good housewife applies in the home. It means carrying out scientifically for the whole town various sorts of restrictions on private property. Some of these are similar to the private restrictions so useful in suburban developments, but the comprehensive laws have the great additional advantage of being under the "Police Power" of the state and of being permanent.

Other features of the laws keep factories or unduly tall or voluminous buildings from invading good business streets.

Zoning conserves all that is best in existing conditions or tendencies and provides for a logical development. It can do more. It can actually direct the growth of the city along the best lines. By studying at the same time as zoning the development of the thoroughfare systems, transit rerouting and extension, railroad relocation, elevation and terminal development, waterways development, playground, parks and parkway development and related problems, the zoning of private property can be so co-ordinated with it that the control exercised will become a dynamic factor for improvement.

However, to be accepted by the courts, a zoning ordinance MUST be reasonable. It must be comprehensive, with a system of logical restrictions covering every part of the city. It must not be piecemeal, nor must it be too complicated.

Experience with the operation of existing ordinances shows that zoning can be simplified. For example, New York City has three separate zoning maps with an aggregate of 14 different kinds of districts. Other cities throughout the country have anywhere from 10 to 19 different kinds of districts. In the proposed ordinances for East Orange these have been reduced effectively to six types of coterminous districts which are readily combined on one map.

We have found that the fire limits which necessarily belong with the building code can be made coterminous with certain zoning districts and therefore can be superimposed on the one map.

Heretofore building lines have been set back only under the power of eminent domain. Several zoning ordinances have tried to force new buildings to set back from the street line a distance equal to the average setback of all of the existing buildings within the block frontage. However, no court and few lawyers have recognized this principle as within the purview of the police power. The East Orange ordinance establishes a new kind of setback building line, whereby for each type of district it establishes uniform front-yard provisions which correspond to the uniform back-yard and side-yard provisions and are equally justifiable with the latter under the police power.

Since the famous Cusak case in Chicago was settled, even billboards can be regulated under the police power. They are more objectionable in residence districts than in business districts and more in the latter than in industrial zones. Therefore we find that it is reasonable to exclude them altogether from strictly residential districts and to regulate them more severely in business than in industrial districts.

Zoning should enhance the attractiveness and the social well-being of the community. The studies along these lines that were started eight years ago in New York are now showing most interesting results in practice. The appearance of streets is becoming more orderly. Large sections of New York are beginning to settle down to a harmonious development, all of which engenders self-respect.

* Of the Technical Advisory Corporation, New York.

In most cities it is now necessary to consult many ordinances and to have plans for even the smallest building alteration approved by from three to seven different bureaus before actual work can start.

In East Orange two ordinances will now cover everything that has to do with building—all that was formerly contained in seven or eight different ordinances. The building code will cover everything that has to do with the control of building construction and with fire prevention. The zoning ordinance will cover everything that has to do with the use of buildings, their height and area and their exterior layout, including their location on the lot.

One of the weakest points in the New York

law lies in the number of matters which are left to the interpretation and discrimination of the Board of Appeals. Anything that can be done to state in the ordinance itself under just what conditions garages or nuisances may be permitted in certain districts will be of the greatest advantage. Thus the East Orange ordinance states definitely that garages shall be permitted in local or general business districts, provided they are made to conform to certain regulations in the text of the law which control effectively most of their objectionable features.

Obviously zoning must not be arbitrary. It must be based on a thorough study of local conditions by men who know from experience what to look for. The specialist must know the pitfalls and adapt the principles that operate well elsewhere to local conditions. He must consult constantly with local men who know all of the ins and outs. He must take the public into his confidence and not dictate. Only thus can a zoning ordinance be effective and reasonable.

Asphalt Paving Specifications Free

In the November 20 issue we described specifications for asphalt pavements issued by the Asphalt Association and stated that we supposed these might be had from the association upon request. The secretary of the Asphalt Association, J. E. Pennybacker, requests us to inform our readers that this supposition was correct and that the specifications will be furnished free of charge upon request addressed to the association at 25 West 43d street, New York City.

Removing Snow from City Streets

Methods used by different cities for removing or otherwise handling snow, including melting; municipal cleaning of sidewalks; mechanical appliances used for removing snow.

Information concerning methods employed and recommended for removing snow from the streets of American cities was obtained and compiled recently by the New York State Bureau of Municipal Information. This included information concerning methods employed in a number of cities, which was obtained by the bureau by correspondence; further information concerning methods employed by traction companies obtained by R. C. Cram, engineer of the Brooklyn Rapid Transit system; and in addition, reports of New York City and the Rochester Bureau of Municipal Research, papers and discussions at the meeting of street cleaning officials held in Philadelphia in 1914; from "Municipal Engineering Practice," by A. P. Folwell; from lectures to postgraduate students at Yale, by Leon F. Peck of Hartford, Conn.; and finally a description of several pieces of mechanical apparatus which have been used or tried for this purpose.

Of the smaller cities reporting, the majority use the old method of shoveling the snow into sleighs and carting it to a river, vacant lots, or wherever else it can be dumped. Carting in sleighs, however, is found to be slow work, partly because of the generally small capacity of the sleigh and partly because of the time required for shoveling the snow out of the sleigh, and dump wagons or dump trucks are preferable for these reasons. In the case of deep drifts, however, powerful tractors cannot force their way if the snow is allowed to collect. Buffalo found that during the heavy storm last winter a steam tractor of 20 tons capacity with a plow attached could not force its way through the drifts, and hand labor became necessary.

Several cities deposit the snow in the rivers by means of manholes in the bridge floors through which the snow is dumped, among these being Binghamton and Auburn, N. Y., and St. Paul, Minn.

In Geneva, N. Y., a heavy timber is put through the hind bob of a bob sleigh and drawn through the residential streets, thus packing the snow. In the business streets a scraper is used next to the curb.

Buffalo places snow fences in the outskirts of the city where there is more or less vacant land and estimates that they have saved the city thousands of dollars.

In most of the larger cities the street railway companies are required to do more or less snow removal. In most cases this consists of brushing the snow from the tracks and for a foot or two beyond. In Niagara Falls the street car company uses plows that are furnished on one side with a blade about 9 feet long, leaving a fairly clear roadway on the tracks and for 9 feet on each side.

Niagara Falls uses what it calls snow removers, which it found more efficient than trucks. They are built of timber about 8 feet wide and carry approximately a wagon load of snow. They are self-loading and self-dumping and if the haul is not too long will remove snow much more rapidly than several trucks, and require the services of but two men, a driver and an operator.

Yonkers, N. Y., last winter found it difficult to keep up with the snowfall, and ice was formed to

considerable depth with the alternate thawing and freezing of the snow. Some of this was broken up for removal by using a steam roller with heavy picks in the rear wheels.

In Rochester, where there is considerable use of sleighs, the Bureau of Municipal Research recommended that certain streets be designated for sleigh traffic and that the snow be left not only on the roadways of such streets but also at the crossings of these streets with the intersecting ones so that sleighs would not become stranded on the car tracks and congest traffic, as has frequently happened.

Sidewalks.—Several cities pay more attention to the thorough cleaning of sidewalks by the city than to the removal of snow from the roadways. Jamestown, N. Y., uses snow plows for clearing the sidewalks, hiring men owning horses. The city last winter was divided into 32 routes. When it snows during late afternoon or night the police department calls these men on the 'phone, usually about 3 a. m., and the sidewalks are usually cleared by the time the first workers appear about 6 or 6:30. About 200 miles of sidewalks are cleaned in this way. If the sidewalk plows are called out during the day the call is given by the superintendent of streets. Niagara Falls has 15 sidewalk scrapers, each operated by a man and horse, which are started to work when the snow reaches a depth of about 2 inches. The scrapers were kept constantly at work day and night during the past winter until sidewalks had all been cleaned up. This method of cleaning sidewalks is reported to be not entirely satisfactory because the city has not yet been successful in obtaining scrapers that will cut close to the sidewalk pavement, and the result is that snow and ice build up on some sidewalks to a depth of 6 or 8 inches. The walks are always kept passable, however.

Melting Snow—Baltimore reported that the government tried the use of flame burning on the snow, but found it entirely unsatisfactory. Other methods of using heat have been tried, including the use of electricity, steam, hot water, oil burners and flame throwers. J. T. Fetherstone found by test that one pound of anthracite coal would melt a little over one cubic foot of loose snow at a cost of $.29½ per cubic yard, as compared with $.24 for truck hauling and $.12 if sewers are used. It is stated that using electricity would require one kw. h. for melting each 25 pounds of snow. An oil burning flame projector invented by L. V. Stevens has been tried on the Canadian Pacific Railroad, the device throwing an incandescent flame some ten feet ahead of the truck. No statement was made as to its efficiency.

The United States Commerce Reports described recently a machine used in the city of Helsingfors, Finland, which would burn wood, coke, coal, kerosene or crude oil. An apparatus weighing 500 pounds and requiring four men to keep it supplied with snow and fuel and using 200 pounds of coke an hour, melted 32 cubic yards of snow in that time. The apparatus consists of an iron furnace, water jacketed all around, a snow receiver or hopper, and a contrivance in which the heat in melted snow is used in assisting in the melting of further snow. Dirt and gravel in the snow are automatically separated from the water to avoid clogging drains or gutters. The machine is said to be used in Finland by street cleaning departments and private property owners. According to the figures just given, one of these machines would remove a one-foot snowfall on a 60-foot street at the rate of 340 feet a day of 24 hours, using 2.4 tons of coke. To clean the 600 miles of streets which New York City is arranging to keep clean this winter would require 10,000 such machines working one day and employing 112,000 men, or 1,000 machines and 11,200 men working for 10 days and burning 24,000 tons of coke. This, of course, is out of the question.

Sewers.—A number of cities have made more or less use of sewers for removing the snow, dumping it into them through manholes, but only during the past four or five years has this shown indications of becoming a general practice. Now most of the cities which are supplied with storm sewers or others of a diameter of 24 inches or larger and with a sufficient velocity of flow and comparatively short run to the river or other point of discharge have adopted this method. These cities include Albany, Buffalo, New York, Niagara Falls, Poughkeepsie and Yonkers, N. Y.; Baltimore, Md.; Cincinnati, Ohio; Newark, N. J.; St. Louis, Mo.; Worchester, Mass.; and undoubtedly other cities.

MECHANICAL APPLIANCES

The past two or three years have seen considerably more extensive use made of mechanical contrivances of one kind or another than had been seriously considered in the past. "In fighting the blizzard of 1920, almost every conceivable type of mechanical apparatus was used. Auto trucks with plows attached in front were successful in some cities. Tractors were employed to push plows or drag graders, scrapers and scarifiers. Rotary plows attached to tractors or to electric street cars proved successful in clearing portions of the street for traffic. In New York a flame thrower was devised and attached to the front of a motor truck. Locomotive cranes with huge buckets and also steam shovels were found effective in Boston and New York. Snow melters were tried in other cities. According to a committee which investigated a demonstration of the Friedman snow tank in New York City, this gave promise of being the most successful of all types of mechanical apparatus for the rapid removal of heavy snowfalls." (This tank was described in PUBLIC WORKS for May 8, 1920.)

"Steam shovels gave effective service in several Eastern cities. In Springfield, Mass., Keystone traction steam shovels, used on snow removal work, were run in 12-hour shifts right through the 24 hours. The same type shovel also was used in New York City. In the latter city the Anorac Engineering and Contracting Corporation which, with other organizations, was pressed into the service of the city in this snow removal emergency, moved its Keystone grader

from an uptown excavating job into the business district and placed it at work loading snow into trucks. The first day it was impossible to get an adequate supply of fuel for the grader, the hauling conditions were so bad. It was also impossible to keep the grader supplied with trucks fast enough to keep it busy, so that the first day it was idle about half the time, but nevertheless removed about 272 yards (city measurement) of snow. Traveling conditions did not improve the second day and, while the number of trucks was increased, the grader still was not working to capacity. As the snow was gradually removed and hauling conditions improved the output of the grader was correspondingly increased until February 14, when a maximum output of 439 yards (city measurement) was reached. The measurement by the city of trucks for the snow removal allowed what is called a heap measurement of 6 feet over the top area of the truck. Most of the trucks have been filled at least 2 feet over the top area, for which no allowance is made in this measurement by the city. The contractors considered that the grader took the place of at least 50 laborers during this entire work of snow removal, even considering the time lost through unforeseen difficulties."

The rotary snow plow has been used by some Canadian cities with satisfactory results. It consists of four blades 22 inches in diameter driven by a 60 horse power gasoline engine mounted on sleds and drawn by horses. The blades are driven at a speed of 500 revolutions a minute and discharge the snow through deflecting hoods on one or both sides of the machine. The apparatus cuts a path 5½ feet wide and will work in snow up to 6 feet deep. It leaves about 6 inches of snow on the roadway for sleigh traffic. In Westmount and Outremount, where these were used, it was estimated that the machines could remove snow from a cut 5 feet wide and 4 feet deep at the rate of $20.79 a mile. It cleaned a 10-foot path 21 inches deep at the rate of 2,258 feet a day and at a cost of 3.7 cents a cubic yard, this including fixed charges for repairs, interest and depreciation. "Such a machine appears to be very useful for opening up traffic where there is sufficient room in the street to permit the snow to remain adjacent; but where snow must be removed the expense would be greatly increased."

SYSTEM ADOPTED FOR NEW YORK

We have already described, in our issue of September 11, the trucks and other mechanical appliances which have been purchased by New York City this year for snow fighting. The committee appointed to report on the subject in 1920, after naming the kinds and numbers of apparatus which it thought desirable, gave a description of the general plan for using the apparatus, which was as follows:

"As soon as a snowfall starts and the commissioner is convinced—after consulting with the Weather Bureau officials—that it will be a continued storm, he will issue orders to have the tractors and trucks begin work. The plows shall be attached to the trucks at the various garages, and the police, fire and street cleaning operators who are assigned to this work shall immediately report for duty and proceed at once to the points where they are to plow.

"The scheme, as outlined, is to have plows in teams of two clean a width of 20 feet of roadway for a distance of three lineal miles in one hour and to continue working over such a route after the snow has ceased falling. The average rate of snowfall is ½ an inch per hour and the motor-driven plows operating at the rate of three miles an hour will cover the entire area every two hours, constantly plowing one inch of snow on each trip up and down the assigned area.

"With 150 tractors and 250 five-ton trucks operating, all of which will have snow plows attached, starting at 200 different points and covering three lineal miles, cleaning 20 feet of roadway, it will be noted that the department will—with its own equipment—have plowed at the cessation of snowfall in each storm six hundred miles of roadway in the important sections of the city, 70 per cent of which will be in the Borough of Manhattan, so that there will be no interruption of traffic such as practically paralyzed the trucking business last year and incurred the loss of millions of dollars.

"This force will be augmented by the hiring of auto trucks to which department snow plows will be attached and it is estimated that 100 of these will be engaged in working in the same manner as the Department trucks and tractors covering an additional 150 miles of roadway. It is intended that this total force will be operated within one hour after the call has been issued by the commissioner, so that if the storm is in progress one hour and it is decided to call out the forces, all the equipment will be in motion within two hours after the storm starts, or in other words, the full force of motor trucks and tractors will be operating when the snow shall have reached a depth of one inch.

"The first point in the work on snow removal is to keep traffic moving. This will be accomplished by throwing the snow from the center to the sides of the roadway. The second point is to have the snow removed as quickly as possible after it is thrown to the sides. For this purpose it is intended to utilize the 100 two-ton department trucks and the department force of carts, approximately 500 in number, on the first day of each storm to haul the snow to the most convenient disposal points, such as sewers and water-front dumps.

"During the progress of a storm, the laborers will be assigned to work at the same time that the call is issued for the plows to start out and they will pile the snow just as soon as it is thrown to the side of the roadway by the plows. This will obviate delay as formerly occurred while waiting for the contractors' forces to begin work, which was usually delayed until the following day.

"The Street Cleaning Department intends to remove the snow with its own force south of 14th street, in the Borough of Manhattan, where the

greatest difficulty developed last year, and to extend its forces, wherever practicable, north of 14th street on the main thoroughfares, such as Fifth avenue, Broadway and other main arteries of traffic, so that the snow will be removed with all possible speed.

"It is purposed to utilize the plows attached to the tractors to push snow from the roadways to the sewer manholes wherever such are available, after they stop plowing, which means that 150 tractors will be pushing snow on all streets where sewers are available and in this way great quantities will be removed quickly.

"The plans also provide for registration of the emergency men in advance of the winter season in order to have an available snow fighting force of laborers report at the 103 section stations throughout the three boroughs, at which places they will be equipped with picks, shovels and pan scrapers; and under the direction of squad leaders, they will be assigned to certain routes for sewering or piling the snow, depending upon the type of sewer adjacent to the various points at which they are assigned to work.

"The rates of pay to attract a sufficient number of laborers for snow work will be determined later in the year, depending upon what a survey of the labor conditions will indicate. As it is intended to make every effort to have the snow removed quickly, a raise in the rates would seem to be one of the means of inducing laboring men to report promptly in sufficient numbers to get the work done rapidly and at a minimum expense, for it is easier to handle the snow immediately after it has fallen than to permit it to be pressed down by the traffic and hardened by freezing."

In a lecture before post-graduate students at Yale University on January 9, 1920, Leon F. Peck, superintendent of streets of Hartford, gave some recommendations for snow removal methods best adapted to conditions usually existing in cities of 200,000 population. He recommended the snow fighting rather than snow removal method for business districts, the use of sewers where practicable, and stated that it was practicable before the war to obtain men for snow removal at the rate of about 2½ to 4 per thousand population, which would give approximately 25 men and 15 teams for each mile of street from which it is customary to remove snow. He concluded by stating:

"Experience indicates that the following methods or rules can be recommended:

"Emergency work should be done under direct control of the city on a day labor basis, rather than by contract.

"Teams and trucks secured by telephone or messenger, from list of owners on file.

"Extra men secured through the regular street cleaners, who should be trained by the foremen to send all the men they can to force organizing headquarters whenever their experience tells them that extra men are needed.

"Emergency foremen should be selected from the list of regular city foremen and inspectors of repairs, road construction, grading, street sprinkling, street lighting, forestry, etc., who are all or in part usually, in cities of this class, under the one street department responsible for snow removal.

"The city's first aid should be directed towards the principal congested center and toward opening up fire department streets to the railway track streets.

"There is little or no financial advantage gained in attempts to use sewers for snow disposal if water fronts and vacant lots are available at practically no greater haul.

"Cities making long hauls and having sewers 18 inches or more in diameter in snow removal sections should surely give the method a trial, with the aid of a hydrant stream if necessary. Economy snow removers, so called, which are simply a large horse-drawn scoop, can be used on short hauls.

"Special openings provided in the floor of bridges are good if the haul can be shortened thereby and the traffic is not too congested for such a provision.

"Road scrapers, either horse-drawn or motor-driven, can be used in clearing pavements, opening gutters, or in piling snow in ridges for removal or in leveling ridges for sleighing.

"All surplus snow thrown from the tracks of street railways should be leveled and pushed toward the curb by the company, using a 14 to 16-foot spreader board 3 feet high attached to the snow plow and adjustable at any angle.

"Gondola or other types of freight cars can be used on the street railway tracks for hauling snow after midnight, and in some cases can be used during the day by closing a few blocks to street railway passenger traffic if the cars can be sent around the closed blocks on the next parallel street."

A 117-Mile Section of Concrete Highway Completed

The longest stretch of concrete paved road that has yet been completed under the Federal Aid Act was formally dedicated and opened to the public at Mason City, Ill., December 23. The completed pavement is a 117-mile link in the Chicago-St. Louis highway. It is the first large project to be completed of the 4,800 miles of hard-surfaced roads that are to form a connected and statewide system of highways in Illinois.

For the most part, the road follows section lines, but there are frequent jogs and many turns. Where these turns are less than an eighth of a mile, new locations have been made and easy reverse curves put in their place. All right angles have been reduced to curves having a radius of not less than 205 feet and the curves are superelevated or banked one inch to the foot, making them safe for traffic at good speed. All curves have good visibility so that approaching cars may avoid meeting head-on at turns.

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems differently will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

How Can Concrete Sheet Piles Be Installed?

Design and installation of plain and reinforced, pre-cast and cast-in-place types. Hollow steel units of very thin steel driven without injury and concreted. Continuous walls made with very thin interlocked joints.

Where permanent sheeting is required, steel sheet piles, especially those with thin webs, are objectionable because of corrosion that will impair them and eventually destroy them under many conditions. Wooden sheet piles may be subject to rapid decay if not continuously submerged, or in sea water they may be quickly and completely destroyed by teredos; besides which, they are difficult to install and subject to serious injury where the driving is hard. All of these objections may be overcome by the use of concrete or reinforced concrete sheet piles.

For long lengths, the piles will need reinforcement in order to enable them to be handled with safety if they are of the pre-cast type. If they are of the cast-in-place type, they will not need reinforcement unless it is requisite to give them the necessary section modulus.

ADVANTAGES OF CONCRETE SHEETING

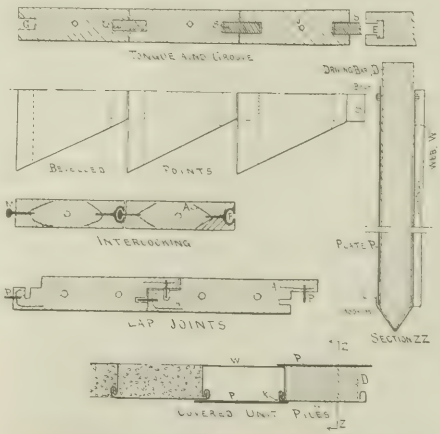
In many suitable places where sheeting is used to retain the sides of excavations, or where it is important to prevent any bleeding or subsequent displacement or settlement of the adjacent soil (as is often the case in trench work in city streets or in excavations close to important foundations or other substructures in quicksand or treacherous soil), or where the sheeting cannot be removed after the excavation is backfilled on account of the displacement occasioned by the movement of the soil to fill up the voids left by withdrawing the sheeting, concrete piles would often be suitable and sometimes as cheap or cheaper than satisfactory wood or steel piles.

In other cases, such as bulkhead walls, wing walls, abutment walls, and many kinds of retaining walls, the thicker concrete piles forming a continuous permanent structure may be economical and suitable and possess the great advantage of being installed without excavation, pumping, or bracing, and may often be substituted by the contractor for some other specified type of construction if a satisfactory design is submitted, and the contractor is able to install them advantageously.

Pre-cast concrete sheet piles have been successfully used in a number of cases but they were generally of large dimensions involving considerable cost in casting and handling and very heavy and extensive driving. When the driving is hard it imposes very heavy impact on the concrete, which often injures them, is objected to by many engineers, and requires slow, costly and difficult operations. Some of these troubles may be avoided by concreting the piles in place by simple, easy methods that have been perfected, but have been little used for this purpose. These methods require driving with the same plant and operations as are used for ordinary wood, steel, or concrete piles, and when applied to the pre-cast methods have the advantages of more economical execution and of eliminating injury and uncertainty in the finished construction. In both cases, ordinary standard hammers or hydraulic jets are used.

TONGUE AND GROOVE PILES

The tongue and groove type is, except the plain, rectangular section, disconnected units, the simplest of pre-cast sheet piles, and may be made with the tongue and groove integral with the



TONGUE AND GROOVE AND LOCK JOINT PILES

pile or, usually more advantageously, with each unit provided with two grooves G and one wooden spline S. After driving, the splines may remain permanently in position or they may be withdrawn and the grooves thus vacated may be filled with concrete, uniting adjacent units. If desirable to provide a positive interlock, the inner ends of the grooves may be enlarged by extension E, which will key the concrete in position.

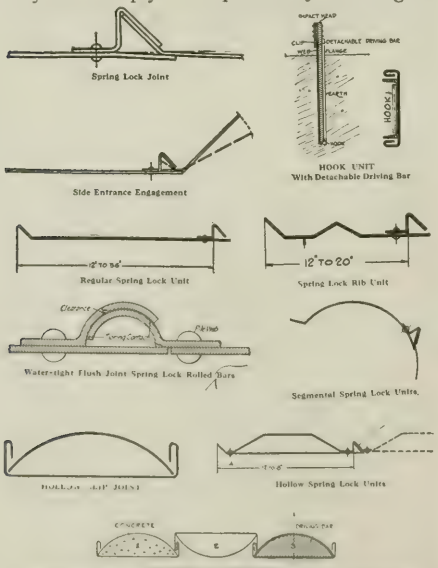
The bottoms of the pile units should be beveled to make them draw together in driving, and there may be one or more full-length jet pipe holes J, cored in each pile unit to facilitate the use of hydraulic or pneumatic pressure in installation.

LOCK JOINT PILES

Pre-cast piles may be provided with regular steel sheet-pile interlocks for the installation joints. These interlocks may be of any available type and are easily and economically provided by splitting a standard steel sheet pile through the center longitudinal line, punching holes through the web of each portion, and casting the male and female members M and F, of the joints, in the concrete, as indicated in the sketch, with bent anchor bars A passed through the punched holes. One sheet pile 12 inches wide will thus provide for the interlock of a concrete pile unit two or three times as wide.

LAP JOINT PILES

A very simple type of concrete sheet pile is made with a ship-lap joint that, if carefully installed, will serve in many cases without any method of interlocking. If it is desirable to provide a positive interlock for this type, it can be easily and cheaply accomplished by inserting full-length projecting plates P, in the transverse and longitudinal faces of the joints to engage corresponding recesses in the adjacent units. These piles can be cast, like most of the other types, in very simple forms and have no delicate projections subject to special injury in driving. Like the other types, they can be provided with jet holes and should have their lower ends beveled to draw together in driving.



HOLLOW SHEET PILE UNITS FOR CONCRETE CONSTRUCTION

Details of their elements, and sections illustrating application of driving bar

CAST-IN-PLACE SHEET PILES

Concrete sheet piles can be installed under any conditions where it is possible to drive a rugged, solid wood or steel pile of the same dimensions, by a combination of the hollow sheet pile unit and driving bar principles. The hollow sheet pile of either the Spring Lock or Slip Joint type can, under favorable conditions, be made of any required dimensions and of extremely thin metal, even as light as 18 or 20 gauge, the limitation usually being the stiffness required for the projecting joint member to be safely driven. This enables the steel weight and cost to be reduced to a very small amount and permits the steel to be left permanently in the ground without involving serious expense.

The spring lock hollow pile can be made with the end entrance or the side entrance joint, and with bent or rolled joint bars, the former being usually much cheaper and more convenient. With the hollow piles the joints are not enclosed in concrete and form exposed sections of the completed structure which may eventually become impaired or destroyed, leaving narrow spaces between the concrete units themselves, a contingency that is not likely to happen for many years and then probably not until after subterranean conditions have been so permanently established that it may not be injurious.

In both cases the lower end of the pile web projects beyond the flanges and is bent 180 degrees to form a hook H, or pocket engaging the lower end of a solid wood or steel driving bar, somewhat longer than the pile unit, which receives the impact of the hammer, relieves the steel pipe of all stress except tension, and is removed as soon as the pile has been driven to required penetration. This provides a very substantial chisel edge that is not injured by encountering ordinary obstacles, can cut through or displace many of them without impairing the integrity of the steel pile, and is entirely independent of the subsequent concreting.

COVERED UNIT PILES

The covered unit type of concrete pile possesses several features of great superiority that make it convenient, economical and extremely desirable for either heavy or thin sheeting where a perfectly regular flat construction of absolute uniformity and integrity is required.

For thin sheeting it is made with ordinary slip joint pile units, all of which are duplicates. Each unit is driven with a driving bar engaging the hook bottom and the lip L, of the hook is extended far enough to cover the lower end of a detachable back plate P, covering the face of the driving bar opposite to the pile web W. As each

successive unit is driven, the web of the slip joint pile is inserted at K, between the cover plate and the joint flange of the previous pile, thus making the steel construction continuous on both sides. The plate P, covering the channel shape hollow of the assembled pile, makes a completely enclosed rectangle which, after the withdrawal of the driving bar is filled with concrete. After the concrete has set the detachable plate P can be withdrawn and used again, in which case it is usually made of heavy metal, but if it is desired to retain it permanently in position it may be made of very thin metal and thus reduce the cost of steel. If reinforcement is required, any desired amount may be assembled and placed in position after the driving bars have been withdrawn.

If the thickness of the sheet pile is considerable it may be more economical to fabricate the steel slip joint piles with two separate patterns, one having very narrow flanges and the other having flanges as wide as the full thickness of the required sheeting, thus locating the interlocks near one face of the pile and using only one thickness of metal for the bulk of the flange instead of the four thicknesses that would be required if all of the flanges extended across the full width of the sheeting.

With this type of sheeting, if the steel eventually disappears entirely through corrosion the integrity of the sheeting will be in no way impaired except by the negligible loss of the interlock, which is chiefly necessary for installation purposes.

The rights to use the patented slip joint, spring lock joint and driving bar features are easily obtained, and the steel piles, weighing, according to width, 3 pounds or even less per square foot of web, can be fabricated from standard commercial sheets at any place where a bending brake of adequate capacity is available, by two or three men, at the rate of 50 to 400 square feet per hour, according to dimensions.

Immigration Notes

Notwithstanding the reports of excessive immigration that are used to justify the support of restrictive measures, the number of alien emigrants from the United States has until now for a long time exceeded that of the immigrants, causing, last year, a decrease of 10,138 in our alien population. During the last fiscal year ending July 1, there were admitted to the United States, exempted especially from the head tax, contract labor law and literacy test, a total of 21,895 laborers from Mexico, West Indies and Canada, all engaged for agricultural work.

Chinese immigration, although still very light, showed an increase of about 1,350 over the number for the previous year. Statistics show that the proportion of females in the total number of immigrants is this year 42.4 against an average of 33.5 for the four years previous to the war. In the ten years previous to the war there were admitted 1,617,018 aliens that would at the present time be debarred by literacy tests.

Dispatches from Warsaw report great numbers of immigrants, largely Russians and Jews, in a destitute condition and infected with disease, that are passing through Poland en route for the United States.

Frederick A. Wallis, immigration commissioner at Ellis Island, states that more than 3,000 immigrants are coming to Ellis Island almost daily and that the arrivals for the fiscal year 1920-1921 will be more than 1,000,000. He estimates that more than 10,000,000, probably 15,000,000, are now waiting in Europe to come here but that they are not all immigrants in the strict sense of the term, many of them being refugees from the war-burdened countries. He estimated that at least 8,000,000 Germans are ready to immigrate here, that 3,500,000 Italians are also ready, and that even the Dutch are immigrating by thousands.

Commissioner Wallis says that "we undoubtedly need a great many of these people, but when our country is in the process of readjustment it undoubtedly would be a good thing if we could establish some sort of differential selection scheme for the admission of these immigrants, excluding the barterers, and the lazy classes that mostly make for radicalism. At present most of them are going to the large cities and should be distributed throughout the country." Mr. Wallis ended by saying "when in doubt, deport."

The tendency toward lower wage scales has become more marked. Reports of reductions in wages of common labor come from all parts of the country, and appear to be confined to no particular industry. Textile mills generally may be said to have reached a lower wage level, and the movement is progressing in the iron and steel and metal mining industries.

Resistance on the part of workmen to lower wage scales is not much in evidence. There are as many instances of voluntary offers on the part of workmen to accept reduced rates as there are of refusals. On the other hand, a few demands for further increases are reported, mostly incident to negotiations for the renewal of agreements.

The Southern Pine Association's Weekly Trade Barometer reports that for the week ending December 24 the production from 105 mills was 30,914,790 feet as compared with a normal production of 73,918,812, showing a production 58.18 per cent below normal. Reports from 84 mills show that during this week 18 were shut down completely, 6 operated one day each, 16 operated two days each, 3 operated three days each, 13 operated four days each, 18 operated five days each and only 10 operated on full time.

Recent Legal Decisions

VALIDITY OF SIDEWALK CONTRACT—ALTERNATIVE AS TO MATERIALS

The Indiana Appellate Court, Indiana Truck Farm Co. v. Town of Schneider, 128 N. E. 617, holds that resolutions for the construction of a sidewalk were not void for uncertainty because they required the sidewalk to be laid on a suitable foundation of "cinders, sand or other equivalent material," and that it be made of crushed stone or gravel. The alternative as to materials did not affect the substantial quality of the walk, and merely gave the owners and contractors an option to use the most available material.

The contract was not void as against public policy because it provided that the contractor was to establish grades and make cuts according to the directions of the engineer, where it also provided that the direction of the engineer was to be according to the plans, profile and specifications, and therefore there was no delegation of discretionary powers to the engineer.

POWERS OF MUNICIPALITIES TO CONSTRUCT IMPROVEMENTS BEYOND LIMITS

In general, a municipality is competent to act beyond its boundaries only in those cases in which it is so empowered by legislative authority, and it is necessary, in passing upon the validity of acts of a municipality performed beyond its boundaries, to look to the general laws and municipal charters for the requisite authority. In certain instances, owing to the urgency of extreme expediency or necessity, express authority is dispensed with and the power of the municipality to perform certain acts beyond its boundary is implied as incidental to the existence of other powers expressly granted. Thus, it has been said that, where a municipality has power to construct sewers, it may, as an implied incident to such power, extend the same beyond its boundaries when necessarily or manifestly desirable, as, for example, to obtain outlets. Likewise, a municipality possessing power to supply its inhabitants with water may acquire for that purpose a water supply without its territory. And certain municipalities have been held authorized to supply light and water to points beyond their boundaries.

Where a city proposed to issue bonds for the construction of a pleasure pier and jetty on its water front, which would extend beyond the city's limits, the proceedings being taken under California St. 1915, p. 99, providing for the formation of districts within municipalities for the acquisition or construction of public improvements "therein," the California Supreme Court held, Mulville v. City of San Diego, 192 Pac. 702, that the statute denies power to construct or acquire such an improvement beyond the boundaries of the district, "therein" meaning in that place.

INJUNCTION OF SALE OF PROPERTY FOR SIDEWALK TAX REFUSED

The Iowa Supreme Court holds, Matson v. Mitchell, 179 N. W. 173, in a suit to enjoin a sale of realty for a sidewalk tax and to cancel the tax, where the principal ground relied on by the plaintiff was that the permanent walk was not built on the permanent grade, and that no such grade was established, the burden of proof was on the plaintiff. The mayor and town council, acting in good faith, passed a resolution ordering the plaintiff to construct the sidewalk. This was known to him, and he knew they were constructing it, with the intention of assessing the cost against his property. He stood by and without objection allowed the town to finish the work and pay the contractor. Plaintiff having the burden, it was presumed, in the absence of evidence to show that the assessment was not according to benefits, that there was some benefit and that the amount determined by the council should be allowed to stand. The plaintiff by his conduct was estopped to enjoin the sale.

EXPERT TESTIMONY AS TO THE UNFITNESS OF SEWER MATERIAL HELD INADMISSIBLE AS IMPROPERLY BASED

In a contractor's action against a village to recover under a contract to construct a sewer from vitrified segment block, taken over and completed by the village under the claim that the material and workmanship were defective, the Michigan Supreme Court, Porath v. Highland Park, 179 N. W. 229, reversed a judgment for the plaintiff and granted a new trial for the erroneous admission of expert evidence that vitrified segment block sewers had been failures in certain cities in the United States and Canada, followed by the opinion of the expert that such failures were due to the unfitness of the vitrified segment block for such purposes. This testimony raised collateral issues which it was very difficult for the village to meet. It raised an issue as to each sewer mentioned, whether it was constructed under similar soil and other conditions, whether the blocks were similar in quality, and after this whether the failure was due to defective material or poor workmanship.

It was held, however, that the contractor could not be held responsible for the use of particular blocks passed under the inspection and by order of the engineer, the contract providing that the work was to be done to the satisfaction of the village engineer and village council; and that evidence that the village engineer had passed certain materials was admissible on the question of whether the work was done according to the contract notwithstanding the council refused to approve. Failure to get the approval of both would not preclude him from showing that his work had the approval of one of them.

NEWS OF THE SOCIETIES

Jan. 10—HARTFORD BRANCH, CONNECTICUT SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. City Club, Hartford, Conn.

Jan. 11—TOLEDO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Toledo Commerce Club.

Jan. 11-13—ASSOCIATED BUILDING CONTRACTORS OF ILLINOIS. Chamber of Commerce Building, Chicago, Ill.

Jan. 14—COLUMBUS SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Engineers Club, Southern Hotel.

Jan. 17-18—OHIO STATE ASSOCIATION OF BUILDERS' EXCHANGES. Ohio Hotel, Youngstown, O.

Jan. 18—WATER POWER LEAGUE OF AMERICA. First annual meeting. Engineering Societies' Building New York City.

Jan. 18-20—IOWA ENGINEERING SOCIETY. Annual meeting. Des Moines, Ia.

Jan. 19 — INTERNATIONAL CUT STONE CONTRACTORS' AND QUARRYMEN'S ASSOCIATION, Inc. Annual meeting. Congress Hotel, Chicago, Ill.

Jan. 19 — AMERICAN SOCIETY CIVIL ENGINEERS. New York City.

Jan. 25 — ATLANTA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with Atlanta Section, A.S.C.E. Carnegie Library.

Jan. 25 — PHILADELPHIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Engineers Club of Philadelphia.

Jan. 25-27 — MICHIGAN ENGINEERING SOCIETY, STATE ASSEMBLY OF THE A.A.E., Detroit, Mich.

Jan. 25-27—CANADIAN NATIONAL CITY PRODUCTS ASSOCIATION. 19th annual convention. Carls-Rite Hotel, Toronto.

Jan. 25-27 — THE AMERICAN WOOD PRESERVERS ASSOCIATION. Place of meeting to be announced later.

Jan. 25, 26, 27—ASSOCIATED GENERAL CONTRACTORS. Annual meeting, New Orleans. Secretary's Office, Washington, D. C.

Jan. 28 — COLORADO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Metropole Hotel.

Jan. 31-Feb. 5—NATIONAL BRICK MANUFACTURERS' ASSOCIATION AND COMMON BRICK MANUFACTURERS' ASSOCIATION OF AMERICA. Joint meeting. Hotel Pennsylvania, New York City.

Feb. 1-2—NEW YORK STATE ASSOCIATION OF BUILDERS. Convention. Rochester, N. Y.

Feb. 1, 2, 3—ONTARIO PROFESSIONAL MEETING in conjunction with the annual meeting of the Engineering Institute of Canada. Toronto.

Feb. 7-8—FLORIDA ENGINEERING SOCIETY. Annual meeting. Lakewood, Fla.

Feb. 9-12 — AMERICAN ROAD BUILDERS' ASSOCIATION. Eighteenth annual convention, eleventh American Good Roads Congress and twelfth National Good Roads Show, Coliseum, Chicago, Ill.

May 17-19—NATIONAL FIREMEN'S ASSOCIATION. Twenty-third annual convention. Fort Wayne, Ind.

June 7-9—NATIONAL FIRE PROTECTION ASSOCIATION. Annual meeting. San Francisco, Cal.

June—CONFERENCE OF MAYORS AND OTHER CITY OFFICIALS, State of N. Y. 12th Annual Conference. Elmira, N. Y.

June 6-10, 1921—AMERICAN WATER WORKS ASSOCIATION. Annual convention at Cleveland, Ohio. Secretary, J. M. Diven, 153 West 71st St., New York.

THE NEW ENGLAND WATER WORKS ASSOCIATION

The annual meeting of this association will be held at Copley Square Hotel, Boston, on January 12, 1921. Besides routine business there will be, at 11 a. m., meeting of the executive committee at the headquarters, Tremont Temple. 1 p. m., lunch will be served at Copley Square Hotel. 2 p. m., reports of committees: "Standards of Purity for Water," Mayo Tolman, chairman; "Revision of Constitution and By-Laws," Henry V. Macksey, chairman; "Standard Specifications for Cast Iron Pipe and Special Castings," Frank A. McInnes, chairman; "Standard Specifications for Fire Hydrants," H. O. Lacount, chairman; "Statistics of Water Purification Plants," George C. Whipple, chairman; "Leakage of Pipe Joints," Frank A. Barbour, chairman; "Standard Specifications for Water Meters," Charles W. Sherman, chairman; "Proposed Standard Schedule for Grading Cities and Towns of United States with Reference to Their Fire Defenses and Physical Conditions," Frank A. McInnes, chairman; "A National Water Law," Caleb M. Saville, chairman; "Extension of Mains," Caleb M. Saville, chairman; "Pumping Station Records," A. O. Doane, chairman; "Watershed Losses," Robert E. Horton, chairman; "Investigate Discrimination in Rates Charged by Fire Insurance Companies against Water Works Pumping Stations and in Favor of Electric Power Stations," Gorham Dana, chairman; "Standardization of Brass Fittings," David A. Heffernan, chairman.

Regular order of business: Report of the secretary; report of the treasurer; report of the editor; report of the auditors; annual address of the president; election of officers—report of tellers appointed to canvass ballots; meeting of 1921 executive committee.

Henry V. Macksey, president; Frank J. Gifford, secretary, 715 Tremont Temple, Boston, Mass.

AMERICAN ASSOCIATION OF ENGINEERS

$500 has been appropriated by the executive committee of the American Association of Engineers from the national treasury to assist in the prosecution of the Pihlfeldt-Young case against the city of Chicago. These two men claim that they were discharged from their respective positions of bridge engineer and assistant bridge engineer without sufficient cause. The Chicago chapter of the A. A. E. is raising a fund to assist in prosecuting the case, and this appropriation from the national association will be paid to the executive committee of the Chicago chapter as needed, and at such times as are approved by the national executive committee.

The American Association of Engineers has appointed a committee of seven engineers to study and report on the various bills presented to Congress for a department of public works. The members of this committee are: George W. Hand, assistant to the president of the Chicago & Northwestern Railway, Chicago; Morris Bien, assistant director of the United States Reclamation Service, Washington; W. L. Benham, consulting engineer, Kansas City; A. N. Johnson, dean of engineering in the University of Maryland, College Park, Md.; Dr. Frederick H. Newell; W. A. E. Doying, chief inspecting engineer of the Panama Canal, Washington; and Dr. A. D. Morehouse, consulting engineer, Washington.

The report of the committee on preferred activities for 1921 recommends: 1. Endeavor to raise level of engineers' salaries. 2. Support Public Works Bill. 3. Support state license law. 4. Increase efficiency of employment system. 5. Promotion of social features in local chapters. 6. Incorporate business education in "Professional Engineer." 7. Increase membership systematically. 8. Manager form of city government. 9. Budget system at national headquarters. 10. Membership to take active part in legislation. 11. Make local chapters more effective. 12. Co-operation with other societies.

In connection with the conference on employment and education held by the American Association of Engineers on November 12, a brief questionnaire was sent to educators and engineers asking for their opinion as to whether engineering, legal and other professional college courses should be preceded by one or two years of general collegiate training. Out of the 154 replies received, 99 were in favor of two years of general education, 43 were in favor of one year and only 12 were opposed to any general collegiate training in addition to the professional course. Fifty-four of the replies were from deans, professors or instructors in engineering colleges and the balance were from consulting engineers, chief engineers and other engineers.

At a joint dinner of the Memphis Chapter of the American Association of Engineers and the Memphis Engineers' Club on December 20, given in honor of a delegation of state legislators, the lawmakers were informed of the contents of two bills prepared for introduction before the recent session of the legislature. One provides for a department of sanitary engineering in the state board of health and the other provides for the licensing of engineers and architects. Several prominent engineers and architects spoke in favor of both bills.

A campaign to find positions for professional engineers thrown out of positions on account of slacking up of engineering work has been undertaken by the Oregon Chapter, which has appropriated a sum of money to be spent within the next three months in advertising in newspapers and magazines. County commissions will be asked to go ahead with some of their work instead of waiting until spring, and other methods will be pursued.

EXECUTIVE BOARD, FEDERATED AMERICAN ENGINEERING SOCIETIES

A meeting of the executive board of the Federated American Engineering Societies was held in New York on December 17, which was presided over by Herbert Hoover, president of the society. Every member of the council was present with the exception of A. M. Greene, and two new members of the board were elected, W. B. Powell and Gardner S. Williams. The following standing committees were appointed: Procedure—Calvert Townley, chairman; Herbert Hoover, ex-officio; W. E. Rolfe, D. S. Kimball, J. Parke Channing, L. W. Wallace and L. P. Alford; Constitution and By-Laws —W. B. Powell, chairman; C. F. Scott and D. S. Kimball; Publicity and Publications—L. P. Alford, chairman; H. W. Buck and H. E. Howe; Membership and Representation—J. E. Oberlin, chairman; L. W. Wallace and A. S. Dwight; Finance—William McClellan, chairman; E. Ludlow, C. Townley, L. W. Wallace, ex-officio; Public Affairs—J. Parke Channing, chairman; Fred J. Miller, L. B. Stillwell.

The immediate program of the council was then considered. Mr. Hoover stated that engineers all over the country seemed to want to join the federation movement, but that the trend was for territorial organization, rather than national. A committee was appointed to look into this matter. It was decided that the American Engineering Council is not to affiliate with the United States Chamber of Commerce. The matter of publicity was then taken up and $1,000 was authorized by the council as an initial fund to carry on publicity work.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS

The annual meeting of the American Association of State Highway Officials was held in Washington December 13-16. Traffic problems, including the regulation of vehicle loads, classification of roads and road types in relation to traffic service value were discussed. Foundation design and structure were emphasized as the primary construction problems of the future.

The opening address was by the Hon. E. T. Meredith, Secretary of Agriculture. He announced that he had urged Congress to enact immediate legislation to continue federal aid beyond June 30, 1921, when the aid provided by the present act terminates. Thomas H. MacDonald, chief of the Bureau of Public Roads, then summarized the federal aid work. A resolution was submitted by C. M. Babcock, Minnesota, calling upon the executive committee, with the aid of a supplementary committee of five, to urge upon Congress the enactment of federal aid legislation.

Traffic problems were next considered. The first paper was one on "Traffic Census," by A. N. Johnson, who commended the practice of Maryland which is distinguished by the careful classification of vehicles, some twenty classes being recorded. A. W. Dean, Massachusetts, took exception to this, holding the classification as too complex, and advocating just five classes. The whole weight of the traffic and not the number and classification of the vehicles is the important question. Uniform state laws limiting the loads on vehicles were then urged by C. J. Bennett of Connecticut. Thomas Maddock, Arizona, and J. N. Cole, Massachusetts, took active part in the discussion which followed on this subject. Methods of regulating vehicle loads were then proposed by J. A. Mackall of Maryland.

The next topic for discussion was road structure. Papers were read by A. T. Goldbeck, C. M. Upham, A. R. Hirst, W. D. Uhler and Clifford Older, all indicating a pronounced trend of thought toward greater consideration of foundation construction and less concern about types of surfacing. An improvement in railway transportation of road materials is predicted for 1921.

W. R. Neel of Georgia urged modification of contract requirements to meet the present conditions. He told of the successful experience this season with a cost-plus contract. F. S. Greene of New York took a stand in favor of the cost-plus contract, which, he said, would encourage contractors and offer opportunities for economy.

Three resolutions were passed all calling for federal aid of some sort. These were: the continuance of federal aid on the basis of present legislation with certain modifications; appropriations by the Secretary of Agriculture of money for research on the basis of equal appropriations by the state; and legislation providing for further distribution of surplus war materials.

MINNESOTA JOINT ENGINEERING BOARD

At a meeting on November 27 the Minnesota Joint Engineering Board elected the following officers: President, Adolph F. Meyer; vice-president, H. T. Downs; secretary-treasurer, Hans J. Meyer. Six societies have ratified the constitution of the proposed Minnesota Federation of Architectural and Engineering Societies.

IOWA ENGINEERING SOCIETY ANNUAL MEETING

The annual meeting of the Iowa Engineering Society will be held at the Chamberlain Hotel in Des Moines on January 18, 19 and 20. Every indication points toward a very successful meeting. A feature of the occasion outside of the usual technical and social program will be the manufacturers' exhibit.

There are now approximately 1,200 registered engineers in the State of Iowa. This fact coupled with the fact that the state legislature meets in Des Moines in January is arousing unusual interest in this meeting.

COMING MEETINGS OF LOCAL SECTIONS OF AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Jan. 18—BOSTON. Joint meeting with the Boston Section of the A. I. E. E. Mr. W. S. Murray, of the Super Power Survey, on the Super Power System.

Feb. 8—Water Power Development and Stand-by Steam Stations as applied to the general subject of Power Development in New England.

Feb. 28—PHILADELPHIA, at the Engineers' Club of Philadelphia. Prof. Dexter S. Kimball, Consulting Engineer, Ithaca, N. Y., on "A Broader Field for the Engineer."

PERSONALS

Andrews, Harry C., former resident engineer, Boone county, W. Va., highway department, is now assistant engineer of public roads, Raleigh county, W. Va.

Lesage, Thomas W., for thirty-three years in the service of the city of Montreal, and recently consulting engineer to the water works department, has resigned, effective January 1, 1921.

Cloney, Thomas, formerly city clerk, has been appointed city manager of Vicksburg, Mich.

Smith, L. B., district secretary of the American Association of Engineers, represented the engineers in New York at the invitation of Mayor Hylan, and in Chicago the association was represented by R. C. Bailey.

Stoner, K. S., chief of the valuation department of the Terminal Railroad Association of St. Louis, has been appointed by President Sherman of the American Association of Engineers on the National Railroad Council of the A. A. E., to succeed Mr. Winship of St. Louis, who has resigned.

Strong, William J. H., of the Lake Breeze Motor Co., of Chicago, president of the Chicago chapter of the American Association of Engineers, will address the Ohio Engineering Society on January 12.

Brown, G. Chester, chief mining engineer for the California Industrial Accident Commission, has been elected president of the San Francisco chapter of the A. A. E., to succeed William S. Wollner. The chapter now has 646 members.

Greene, G. B., general manager of the General Supply Co., of Canada, Ltd., was re-elected president of the Ottawa branch of the Association of Canadian Building and Construction Industries at the annual meeting a short time ago.

LeClair, Georges C., has been appointed superintendent of the incinerator department of the city of Montreal, to succeed J. E. Nantel, who is retiring.

Howard, Norman J., bacteriologist in charge of the filtration plants of the city of Toronto, has resigned in order to accept a position as manager of the water works department of the General Supply Co., of Canada, Ltd.

Graeser, C. F., formerly resident engineer on design and construction of municipal improvement work with W. B. Saunders, consulting engineer, Helena, Mont., has accepted a position as assistant engineer, Minnesota Highway Department.

Phillips, Hiram D., assistant division engineer, Massachusetts State Department of Public Works, Bureau of Highways, has been appointed engineer of District No. 2, Franklin and Hampshire counties, Conn., to succeed C. H. Howes, resigned.

Klorer, John, vice-president of the New Orleans Chapter of the American Association of Engineers, has been appointed city engineer of New Orleans.

Peabody, Lionel Henry, Jr., civil engineer, who at two different times was in the employ of the Rhode Island State Highway Department, died on November 15, at Shawomet, R. I.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

HAUCK CONCRETE HEATERS

Oil-burning heaters made by the Hauck Manufacturing Company are illustrated in their bulletin No. 130, which deals chiefly with heaters intended to be used for concrete placed in cold weather. The successful application of the Hauck devices to a number of important construction jobs are there described and illustrated.

A heater that is used with any type of concrete mixer has a kerosene oil burner that produces an intense flame projected by air pressure into the interior of the mixer in operation, where it maintains the temperature of the aggregate uniformly at 90 degrees or higher if required, thus eliminating the necessity for heating the water or aggregate in advance.

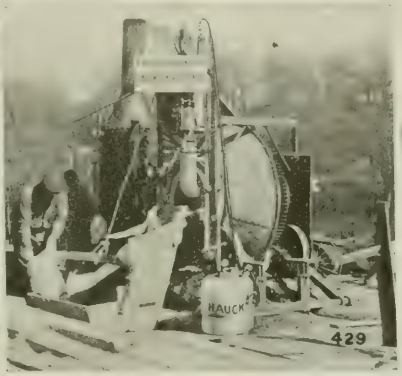
The heater equipment consists of a compressed air tank and a burner, shown in the engraving at the left, which is connected to it by a flexible pipe with additional lengths of steel pipe if necessary. The burner is attached to the framework of the concrete mixer and the lower end is inserted in the charging hole. It requires very little attention and can be operated by any ordinary workman. It is made in two sizes provided with hand pumps which need operation only once in three hours, and burns from two to three gallons of kerosene per hour. Best results are obtained from an air pressure of 40 to 60 pounds. Larger tanks are furnished when the air can be received from a compressor.

Thawing machines consisting of a Hauck burner connected to a small tank with a hand pump are recommended for thawing out ground preparatory to excavation, for foundations, and for laying concrete floors and melting ice and snow around frozen forms, etc. A few minutes' operation of the hand pump will provide pressure for three hours. A contractor laying conduit, with 2½ feet of frost in the ground, thawed out 300 linear feet in an 8-hour day. One of these machines is also able to thaw out a frozen sand, gravel or stone car in from 1 to 3 hours.

The kerosene salamander has a Hauck burner delivering a great volume of intense heat to a perforated cone that has a larger radiating area than any coal or wood-burning salamander and can be operated without danger of fire to adjacent wooden forms. It is made in three sizes consuming from two to three gallons of oil per hour.

Hauck burners are also used for illuminating purposes, and give a clean white flame free from smoke, that will not flicker in the wind or draft. The company also has manufactured an easily installed high-pressure type furnace burner that will burn any grade of oil when supplied with steam or compressed air at 20 to 100 pounds pressure, and is recommended for raising steam in boilers for the engine, hoist and crane. The burner lights easily without pre-heating and is easily regulated, it can be set to work by gravity or under pressure or by siphonage. It is manufactured in four sizes with an oil consumption of from one to twenty-five gallons per hour and with an air or steam consumption of 8 to 20 cubic feet per minute.

HAND PUMP TYPE OF BURNER

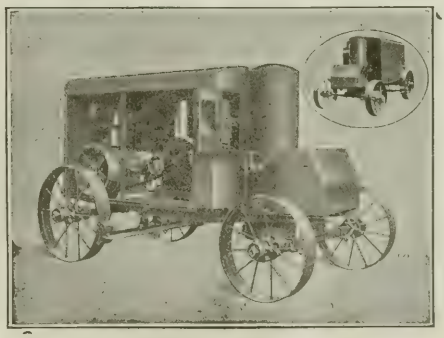


A No. 90 HEATER ON A 1½-YARD MIXER

ONE MAN THAWER

IMPERIAL PORTABLE COMPRESSOR

For the service of contractors, street railways and public service companies that have available electric current, the Ingersoll-Rand Company offers a new electric motor-driven Imperial air compressor of 118 cubic feet capacity that weighs about 4,450 pounds. It is made entirely of steel, mounted on a steel truck and enclosed in steel housing with easily removable doors.



MOTOR DRIVEN COMPRESSOR OF 118 FEET CAPACITY

It is operated by either direct or alternating current motor with standard control and is equipped with a suitable incased intake unloader providing efficient regulation. Additional equipment includes air receiver, safety valve, drain valves, pressure gage service valves and hose lines.

The Yonkers Electric Light & Power Co., 9 Manor House square, Yonkers, N. Y., has completed plans for $75,000 electric power station.

MEAD-MORRISON TRUCK WINCHES

Truck winches manufactured by Mead-Morrison have been developed by specialists to secure the best results in quality, compactness, strength, durability and simplicity of operation especially intended to decrease idle time in loading and unloading trucks, thus making the operation of the latter more profitable.

For ordinary contract work the vertical capstan winch is preferable, and is particularly suited to pulling heavy material on and off the platform body. This winch is made in two sizes weighing 100 pounds and 300 pounds, respectively, and having a single line pull of 2,000 or of 5,000 pounds at the rate of 50 to 60 feet per minute.

TRUCK WINCH

On dump body trucks, the horizontal capstan winch is preferable when used only occasionally for pulling the trucks out of mud holes, but if it is used for pulling trailers and backfillers and to assist the truck in rough ground, the underslung drum is best because the rope is at all times coiled on the drum. The size of winch does not depend in any way on the size and model of the motor truck, but wholly upon the work to be done by the winch.

The light-duty horizontal winch, attachable to the side of the chassis, weighs 100 pounds and develops a 2,000-pound pull at a speed of 50 to 60 feet per minute.

Underslung drum winches weigh 550 pounds, have a maximum rope pull of 5,000 pounds, a drum capacity of 425 feet of 7-16-inch rope, and are mounted under the chassis where they occupy no space required for other purposes.

The manufacturers have also developed a sturdy, convenient and efficient truck crane of 1-ton capacity that can easily be installed on a motor truck, just behind the driver's seat, where it is operated with power from the motor. It has a hoist of about 10 feet with a working radius of 5½ feet and can be almost instantly installed and removed.

SOLVAY PAINTS

The Solvay Process Company offers a number of special brands of paint for specific purposes. Solvay stack paint, black, made from refined retort coke-oven pitch, will withstand great heat and is efficient up to 750 degrees Fahrenheit, beyond which temperature no paint can endure long. It is recommended for boiler stacks, draft flues, boiler fronts, steam pipes, etc.

Solvay graphite paint is a slow drying black paint for outside use, recommended for all kinds of structural steel. It has a covering capacity of 550 square feet per gallon, and dries in from 20 to 30 hours. It is made of graphite flakes cemented together with refined pitch. It is waterproof and unaffected by weather.

Solvay No. 10 Crysolite is also a black slow drying protective paint for structural steel work, for outside use only, and is stated to be in appearance and durability, the equal of the highest grades of graphite and linseed oil paint at about one-half the cost.

Solvay hydraulic paint is a heavy bodied black pitch paint with a covering capacity of 400 square feet per gallon (equal to 3 tons of architectural steel). Dries in from 12 to 16 hours, is uninjured by lime or alkali found in cement or mortar which may be placed against it, and is recommended for architectural steel and for all submerged steel work.

Solvay concrete coating is a black dense, insoluble pitch compound with a covering capacity of 80 to 100 square feet per gallon, which is recommended for waterproofing brick, stone and concrete walls and cement floors.

INDUSTRIAL NOTES

The Prospect Construction Co., Inc., has opened an office in Philadelphia, Pa., to engage in general contracting and engineering work.

The Concrete Engineering Co., Omaha National Bank building, Omaha, Neb., is now building new warehouse space at its Chicago and Omaha plants, and providing additional manufacturing facilities which will enable them to carry larger stocks of their Ceco fireproofing and reinforcing materials.

Charles T. Topping, formerly of the Charles T. Topping Machinery Co., Pittsburgh, has decided to re-engage in the construction machinery business for himself. He has established his organization in the House building, Pittsburgh, and will act as district sales representative for the Austin Machinery Corporation, of Chicago.

Messrs. George Oldham & Son Co., manufacturers of pneumatic tools and appliances, Baltimore, Md., have established a branch at 165 High street, Fort Hill square, Boston, Mass., under P. Woolfolk. This company also carries a supply of tools and parts in Montpelier, Vt., which are distributed by Daniel McGovern.

A modern plant costing about half a million dollars will be built on five acres of land on the corner of Hanson street and Coxwell avenue, Toronto. Three companies will begin operations in the plant when it is completed; these being Crouse-Hinds Co. of Canada, Harvey-Hubbell and the Hubbell-Mack Machine Screw Co.

The DuPont interest has taken over the mill on the River road at Buffalo that was started by the Philadelphia Rubber Co. and whose construction was stopped some time ago. After changing the plans somewhat, the DuPont Co. is to complete the mill and begin manufacturing fibre silk there.

LA FRANCE EQUIPMENT EXCEEDS TEST REQUIREMENTS

Waterloo fire department's two new La France combination truck and engines met every requirement at the official tests December 13 and the apparatus was formally accepted. Interest was especially keen in the performance of the big type 12 motor and engine pump, and the great stream of water hurled 200 feet at a rate of 1,036 gallons a minute.

Official markings on the tests of the pumping engine rated at 1,000 gallons per minute at 120 pounds pump pressure were as follows:

Capacity test: Three lines of hose, 300 feet, 200 feet and 100 feet long, combined into one deluge nozzle with 2-inch tip, developed pump pressure of 120 pounds; nozzle pressure, 76 pounds; vacuum, 20 inches, and discharged 1,036 gallons of water per minute.

Pressure tests, rated to deliver 500 gallons per minute; one line of hose 200 feet, with 1¼-inch nozzle tip, registered pumping pressure 205 pounds; nozzle pressure, 126 pounds; vacuum, 12 inches; water discharge, 520 gallons per minute.

Special capacity test: Three lines each 200 feet, with three streams, developed a pump pressure of 100 pounds; nozzle pressures, 79, 70 and 80 pounds; vacuum, 20 inches; water delivered from three 1⅛-inch nozzles, 961 gallons per minute.

Special capacity test: Four lines of hose each 200 feet, and four streams from 1-inch nozzles, developed pump pressure of 90 pounds; nozzle pressures, 80, 72, 70 and 70 pounds; vacuum, 20 inches; water delivered, 1,013 gallons per minute.

The junior pumping fire engine and truck, with a rated capacity of 300 gallons per minute, delivered 337 gallons per minute through 1-inch nozzle and 200 feet of hose.

Manufacturing operations will soon begin at the new plant of Machinery & Foundries, Ltd., on Pearl street, Brockville, Ontario, which is now rapidly nearing completion. The industry, which is a new one for the town, will comprise a general foundry and machine shop business, with special attention to pumps of all descriptions, both hand and power-operated.

The Chicago Bridge & Iron Works, 37 East Van Buren street, Chicago, Ill., announce the opening of a new sales office in the Forsythe building, Atlanta, Ga. This office will be in charge of Joseph L. Zeller, who will cover the states of Georgia, Alabama, Tennessee and Florida.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Entered as Second Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879

Vol. 50 **FLORAL PARK, JANUARY 15, 1921** **No. 3**

Difficult Swamp Road Construction

Wide sand embankment sunk to hard bottom 35 feet deep. Fresh fill settled 8 feet overnight. Original surface upheaved 8 feet. Hard bottom brought to top alongside embankment.

Contract 18 of the State Highway Department of Delaware, for a section of standard concrete roadway, was awarded to the Piel Construction Company, Baltimore, which executed the work under the direction of Charles M. Upham, chief engineer. A portion of the road, which was built under a sub-contract awarded to Sherman & Rhoades, is located for about 700 feet through a swamp which, it was indicated by preliminary soundings, consisted of mud and peat to hard bottom at a depth of about 35 feet.

Over this soft ground, concrete pavement will be constructed on an embankment 36 feet wide on top, with sides sloping at the natural angle. The top of the embankment is about 6 feet above the original surface of this swamp and the embankment contains 57,000 yards of sand from a borrow pit about 2,000 feet distant.

Work on the swamp was commenced about June 15 and was completed in October. The whole 700 feet of the embankment has apparently reached a stable condition, although settlements, very deep and rapid at first, continued with decreasing amounts for many weeks after the deposition of fill was commenced at any point. Estimates made from the original cross sections indicated that about 18,450 yards of fill would be required, and it was contracted for at the unit price of $1 per yard, measured at the borrow pit, a reasonable figure which, for the originally estimated quantity, would have yielded only a narrow margin of profit.

Sand was excavated in the borrow pit by a Bucyrus steam shovel with ¾-yard dipper working on a vertical face about 14 feet high and delivering to 1-yard steel boxes balanced on supports built up on eight Ford trucks. The trucks, under the personal supervision of one of the contractors, made a round trip from shovel to embankment and return in an average of 8 minutes. A corduroy road made of transverse planks was laid on top of each lift of the embankment as fast as the latter was built, and the trucks passing over it, turned around at the end of the lift,

PLANK ROADWAY FOR DELIVERING FILL IN SWAMP. SETTLEMENT AFTER 30-FOOT EMBANKMENT HAS BEEN MADE

backed close to the edge, and were dumped by hand.

The embankment was built with nine successive lifts or layers from 5 to 10 feet thick, the sides of which sloped about 1 to 1 at the top of the embankment where it is exposed above the surface of the swamp. As fast as one lift was completed, the loose planks were stripped from it and placed on top of the succeeding lift, which sometimes could hardly be made as fast as the settlement progressed after it was started. Usually the thick mat of grass and roots and top crust of the swamp sufficed to sustain the first lift of the embankment with only a few inches of slow uniform settlement, not enough to break through the crust. After the first lift had been made for a length of about 100 feet the second lift, of about 6 feet, was made like the first one, commencing at the south side of the swamp and working north, and soon afterwards rapid and irregular settlement commenced breaking through the crust, and allowing the fill to displace the soft, wet material below it.

ONE LIFT PLACED AND SETTLED IN SWAMP, AND SECOND LIFT BEING PLACED

The sand penetrated through the turf and mud to final bearing on the hard clay bottom of the swamp basin. The extensive transverse displacement of the plastic soil caused horizontal and vertical movements in it that produced upheavals of from 4 to 8 feet above the original surface, for distances averaging from 30 to 60 feet beyond the embankment.

The irregular surface of the upheaval was of a rolling character, with the grass and vegetation at first little disturbed but finally often breaking in long cracks through which mud and clay often extended. The appearance of this clay, spouted up through these openings, is interpreted to indicate that the fill has reached hard bottom and that a little of it has adhered to the layer of soft materials displaced. Soon after this occurred the settlement ceased and the embankment apparently attained final stability.

Sometimes a considerable length of the apparently completed embankment would settle 6 feet in 24 hours. The settlement was very irregular in location, character and rapidity, sometimes commencing in the center, sometimes on one side, and then on the other side, or sometimes uniformly, or on either side alone. In one case a settlement, greater on one side than on the other, was so rapid that the planks remaining on top were displaced to an inclination of 20 degrees from the horizontal.

Sometimes settlement occurred on the middle line without much occuring on the sides, thus producing a V-shaped trough 60 to 70 feet long and 9 to 10 feet deep, with a regular cross section that continued to settle so that an 11-foot lift only raised the surface 2 feet. In another place 8,000 yards of sand were required in two weeks for fill on a settled section less than 100 feet long.

Care was taken to have enough trucks in service to keep the steam shovel working almost continuously at the rate of about 500 yards per day. The rough, soft road, steep grade, and rapid work proved severe for the trucks and required the constant services of one man in the repair shop to keep them in order. The most serious trouble was the stripping of the reverse gears, caused by backing up steep grades. Provisions were made for this so that the gears could be replaced overnight.

This fill has been completed and has apparently reached a firm foundation. Levels will be taken during the winter and spring to determine the settlement that takes place during the winter season.

SHOVEL IN BORROW PIT LOADING 1-TON TRUCK WITH 2 DIPPER FULLS

Road Builders' Truck Turntable

A portable turntable that is especially convenient for handling motor trucks that deliver material for concrete road construction is illustrated in the "Concreting Highway Magazine."

The turntable has a wooden platform large enough to receive the wheel base of the largest trucks served, that is mounted on wheels running on a circular track rail and

pivoted to the frame by a vertical steel center pin. The track is made in three hinged sections so that the two segments projecting beyond the platform can be folded up and the inclined platforms connected to each end of the revolving platform are hinged to it and can also be folded up, making the whole construction very compact for easy transportation. The turntable was used by Charles Spindler, contractor for 4 miles of concrete road in Alabama.

Water Works Notes in Europe

Interesting details of the Liverpool and Sheffild water works. Sewage used as compensation water for factory use.

In a trip made in 1919 by Thorndike Saville, some interesting features concerning English water works were observed and recorded in his notes of the trip.

The Liverpool water supply is obtained from two main sources, one at Rivington, the other at Vyrnwy, 77 miles from the city. Owing to inaccurate rain-fall data on which the estimates were based, the Rivington source has contributed only ⅝ of the estimated yield. At Lake Vyrnwy the water is filtered and is then strained through 60-mesh screens at the Prescott distributing reservoirs about 7 miles from the city, but in spite of this screening there has been trouble from deposits of clodothrix in the mains from the impounding reservoirs and in some of the city mains.

In one of the reservoirs at Prescott there is a pendulum valve on the outlet to the distribution mains, which is so devised that, in case of a break in the mains, the increased velocity of water through the pipe moves the pendulum, a ratchet on top of the pendulum is released and the emergency valve gate drops, cutting off the flow of water.

There is no standard of color used generally in England, such as the platinum-cobalt standard of the United States, and the color of the Liverpool water is stated as being 4.6 measured by a standard devised by the brewers for comparing colors of beer.

A unique proposition was being considered for securing additional water supply for the city of Sheffield. The matter was then being heard before the committee of the House of Lords, which was taking the evidence of many of the most noted sanitary engineers and chemists of England. The proposition involved the return of sewage, after it had been treated by the activated sludge process, to a compensation reservoir above the city, where it would be diluted with river water and used for factory and mill water supply. The water supply of Sheffield is limited and a series of three dry years would produce a water famine. It was necessary, however, to take water from the river Don or to spend 15 years in constructing works to obtain it from Scotland. After being diluted with river water, it was proposed to take 5 million gallons per day of the mixture, soften it by use of $NaCO_3$; sterilize (possibly) and pump to a balancing tank, from which it would be distributed to industrial plants along the river. The scheme was objected to by the Local Government Board on the score of sanitation, depending on the efficacy of the activated sludge treatment; if this is as good as the experiments, the board would be satisfied. The mill owners objected that the reaction of the $NaCO_3$ with iron salts from the steel works would probably produce a scale-forming ingredient in the water. On the other hand the city claimed that the river water would be improved from a chemical standpoint and the mills would be relieved of part at least of the cost of softening which they now are burdened with, as it could be done more cheaply at the central plant of 5 million gallons capacity.

In France Mr. Saville noticed a much more general use of concrete for water tanks than in the United States, and they seemed to be tight and dry as well as artistic.

Flood Control by Small Dams

Suggests inexpensive retention dams, similar to those of the Miami Conservancy District, but on a smaller scale, on the various tributaries.

In an address before the Tenth Annual Drainage Convention at Washington, N. C., Thorndike Saville, associate professor of hydraulic and sanitary engineering in the University of North Carolina, suggested consideration of methods of controlling or reducing the peak flow of floods in order to prevent damage done by such floods, reference being made to erosion of drainage ditches as being of special interest to those before whom the address was given.

"The problem is to so regulate the discharge of flood water to a stream that it will rise only a predetermined amount beyond its normal level. For this purpose it is necessary to study the catchment basins of the tributary streams.

"It is necessary to know their rate of flow in flood, the time interval which their flood crest takes to reach the main stream, and the effect of the various tributary floods on the flood crest in the main stream. It is when the flood crests from a considerable number of tributary streams reach the main stream at nearly the same time that great floods result. Often by straightening and widening channels the delivery of flood waters from some tributaries may be hastened and the flood in the main stream reduced in magnitude.

Since the total amount of water to be delivered is not greatly affected by such measures, the duration of flood in the main stream will be extended, though its magnitude is decreased.

"When the measures noted in the preceding paragraph are ineffective or impossible to achieve it becomes necessary to construct retention reservoirs. By this is not meant necessarily the creation of large impounding reservoirs by high dams. It is frequently possible on small streams to erect low dams on the tributaries, such that the flood waters may simply be retarded to a sufficient degree to prevent simultaneous discharge of flood crests to the main stream. In many instances in drainage projects it is possible to place one or more such barriers on the main stream itself. The construction of such retention basins is probably best effected by a somewhat similar procedure as is being applied on a large scale in the Miami Conservancy District near Dayton, Ohio. This method consists in constructing retarding basins at selected points on the tributaries and main stream. In the case of drainage districts served by a 'flashy' stream, a low dam may be located at an appropriate place with a culvert opening in it. During normal flow the culvert discharges the waters of the stream as if no dam were there. During flood flow the discharge of the stream increases beyond that for which the culvert is designed and water is impounded behind the dam. The culverts then discharge under a hydrostatic head and are so designed that they will deliver water at such a rate as to keep the height in the main stream below a predetermined level. As the flood flow decreases the culverts continue to discharge until the impounding basins are empty. Such a scheme may be quite inexpensive as compared to elaborate construction of levees and increased size in ditches and canals to take the flood flow.

"The suggestions in the preceding paragraph relate primarily to the construction of low, inexpensive dams to create retarding basins. A similar control of floods may be obtained by the construction of higher dams creating large storage reservoirs. Here the reservoir may serve the double purpose of flood regulation and power development. Such structures are relatively expensive and are economical only under conditions of good dam site, fairly large normal flow of the stream, and a market for the power. There are doubtless some situations in North Carolina, particularly in the Piedmont District, where such developments would be profitable. The utilization of our smaller water powers is becoming increasingly important, especially in the cheap production of electric power for promoting conditions in the rural districts equal in convenience and comfort to those in the city. The co-ordination of water power developments and flood regulation in drainage districts is one of the more practical means of meeting this problem."

Treating Sewage by the Dorr System

Sedimentation secured by radial surface flow, and continuous removal of sludge revolving plows. Description of the Mt. Vernon plant, containing a special type of screen and of activated sludge apparatus, which gave unusual efficiency of the air used.

A few weeks ago a paper was read before the Boston Society of Civil Engineers by R. H. Eagles describing apparatus devised and marketed by the Dorr Co. for securing the sedimentation of sewage and trade wastes and removing the sludge from the same, which paper was discussed by Edward Wright, assistant engineer of the Massachusetts State Department of Health, Harrison P. Eddy of Metcalf & Eddy, engineers of Boston, and by Robert Spurr Weston of Weston & Sampson, also a Boston engineering firm; all of whom are well known in the field of sanitary engineering.

Mr. Eagles opened his paper with a discussion of certain features of the theory of sedimentation which forms the basis of the Dorr methods and apparatus; which theory is given below, somewhat condensed.

"Generally speaking, the basic factor in causing solid particles to settle from a flowing liquid is decrease in current velocity to secure the maximum attractive effect of gravity upon the particles. This effect would normally be expected to result from the expansion of the cross-sectional area of the flow into any shape of basin.

"The assumption is doubtless the basis of the general practice of figuring sedimentation basin capacity to give arbitrary volume detention in hours. In our opinion, this basis is not entirely correct as it assumes that the time required to fill a basin under a certain flow will be the period of detention, whereas in actual practice this would mean perfect distribution of flow across the entire cross-sectional area of the basin. This condition is next to impossible and difficult to even approach.

"The use of over-and-under baffles in single-story settling basins has been frequently used to approach this ideal distribution of feed, but it would appear that the constriction in cross-sectional area of flow at each baffle is defeating the original purpose of the basin by increasing current velocity at those points."

The Dorr Co., in its apparatus, relies upon the

method of expanding the surface area of flow to a maximum, securing uniform surface distribution by radial flow from the center of a cylindrical tank to uniform flow over a peripheral weir. This reduces the question of settling basin capacity to that of allowing an area of surface sufficient to reduce the depth of the zone of surface flow to a minimum, so that settling particles will have a minimum distance to fall before escaping the influence of the flow zone. The factors are apparently the velocity of vertical motion of the settling particles, the depth of the liquid flowing from inlet to overflow weir, the velocity of such flow, and the percentage of settleable solids which it is desired to remove.

The rate of subsidence of two feet per hour would give a settling capacity per square foot of surface of 15 gallons per hour, and a tank 100 feet in diameter with a 2-foot rate of subsidence would provide a settling area sufficient for a flow of about 2½ million gallons a day.

There are, in addition, a number of factors which must be considered in estimating and planning such apparatus, these including velocity of surface flow, velocity over weir, variation in quantity of flow, variation in chemical and physical character of sewage, and variation in temperature. It is assumed that no sludge will be allowed to remain in the tank sufficiently long to begin putrefaction or the creation of gases which, in rising, would interfere with sedimentation. If the basins are not cleaned continuously or at frequent intervals, some depth must be allowed for the storage of sludge, but with the Dorr apparatus there is continuous removal of the deposit and, theoretically, one foot depth is as good as six so far as the clarity of the effluent is concerned.

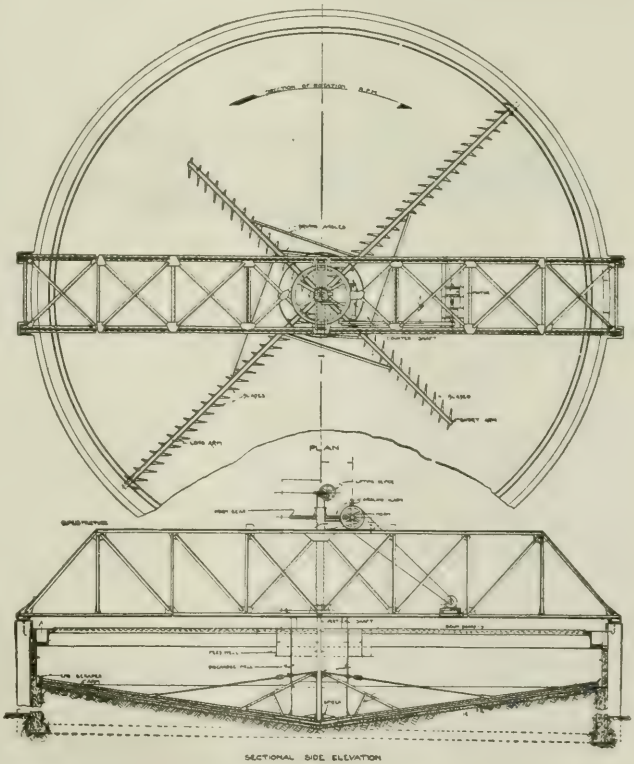
It is claimed that this clarifier secures the following conditions: The even distribution of flow from feed to overflow weir; maximum length of overflow weir consistent with practical design; true level and alignment of overflow weir; absence of obstruction (such as baffles) which will create eddies and stray currents; protection in certain cases against formation of wind riffles; elimination of gas channels; and continuous removal of settling solids in such a manner as not to create any interfering currents.

"The question of overflow velocity at weir is an extremely important one. Upward currents are created which tend to lift the lighter solids and carry them over. Light solids which have settled to a depth of 12 inches by the time the outer limits of a tank are reached are sometimes caught in the zone of this upward current and removed in the effluent, thereby defeating the process of sedimentation for such particles.

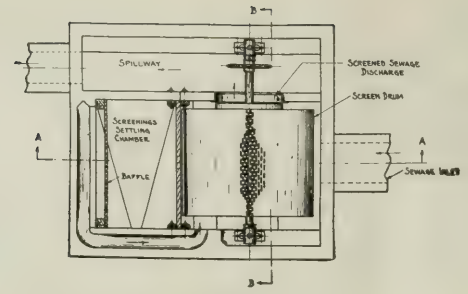
"The depth at which these effects are noticeable is directly dependent upon the weir velocity, and by securing the maximum length of weir consistent with uniform distribution, the conditions will be best cared for."

In discussing this matter of sedimentation, Mr. Weston cited, as an illustration of the fact that a shallow tank for sedimentation is no new idea, a paper by Allen Hazen entitled "On Sedimentation" in volume 53 of the transactions of the American Society of Civil Engineers, in which Mr. Hazen discussed the efficiency of an assumed basin in which the water passing through it flows in a thin layer while the water below it remains quiet or nearly so.

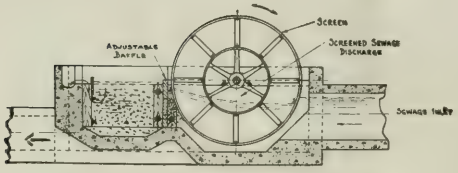
Continuing with the discussion of clarification, Mr. Eagles stated that where the very finest solids and colloidal matter must be removed, floc-



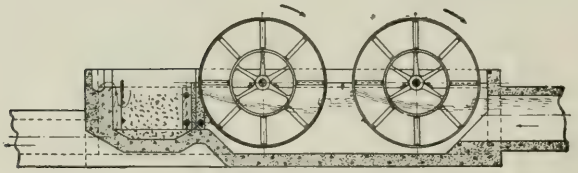
THE DORR SEWAGE CLARIFIER.



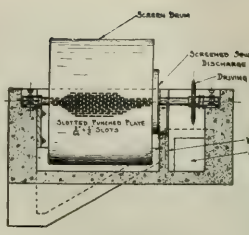
PLAN VIEW



SECTION ON A A



PARALLEL ARRANGEMENT
THE DORRCO SCREEN



SECTION ON B B

culation must be resorted to, an agglomeration of fine particles into readily settleable floccules being brought about by the introduction of certain electrolytes or coagulants. The formation of floccules may be rapid and complete or slow and incomplete. The rate of settling increases with the growth of the floccules and the maximum rate may not occur until after 30 minutes or more. The detention of the liquid dosed with coagulant to take advantage of the maximum settling rate is obtained by submerging the feed well the distance necessary for volume detention, with due regard to proper distribution and elimination of short circuits.

The essential feature of the Dorr clarifier is a slowly rotating mechanism consisting of radial arms carrying plows which mechanically collect all the solids which have settled and reached a condition suitable for removal. The solids collected by the slowly revolving plows are piled up around the outside of the central sludge well and form a sludge seal around its bottom opening, so that only the thickened sludge can find its way into the well when the sludge pump is operating.

A thickening action takes place by reason of the compacting effect of the plows, which tend to press the sludge particles together in moving them to the center. At the same time the plows open up channels in the sludge bed to allow the water which is squeezed out to escape. The sludge leaves the basin with a consistency considerably denser than would be obtained by the action of gravity alone in a shallow basin.

One plant was referred to where a clarifier 32 feet in diameter was handling an average of 600,000 gallons a day and removing 95 per cent of settleable solids and producing a sludge that has analyzed as low as 67½ per cent moisture and recently averaged 70 per cent; the sewage treated being domestic combined with gas house and straw board factory wastes. A cone-bottom type of settling basin with a 97 degree bottom slope (Dortmund type) produces a sludge of 93½ per cent moisture content, operating under identical conditions and twice as deep as the clarifier.

The process and device was first used for treating trade wastes, such as waste water from tanneries, glue and gelatine manufacturing processes, packing houses, textile mills and manufacturers of milk products, dye stuffs, etc. In most cases such treatment plants are installed because they are required by the state health authorities, and manufacturers adopt devices which save labor as much as possible and insure uniform results without technical supervision.

MODIFICATION OF ACTIVATED SLUDGE PROCESS

Early in 1919 the city authorities of Mt. Vernon permitted the Dorr Co. to establish at their sewage treatment plant an experimental station where about 45,000 gallons per day of fresh sewage was passed through a tank devised by C. Lee Peck, director of research and development of the sanitary engineering department of the company, for utilizing the activated sludge process. Mr. Peck's idea was to evolve an apparatus that would

secure a high efficiency from the air in order to reduce operating costs to a figure comparable to that obtained by other systems in general use.

"It was observed that a considerable portion of the air which was diffused into the open type of aeration chamber was inefficiently used to keep the body of sewage in agitation, the object being to produce prolonged contact between air bubbles, activated sludge flocs, and fresh sewage. It appeared as though the agitating effect of the air could be mechanically improved, as many of the bubbles escaping from the open type aerator pursue a straight-line course from the diffusing tile to the surface, without having done appreciable work, either chemical or mechanical.

"This inefficiency is shown by the fact that the normal oxygen consuming value of the activated sludge mixture is approximately .05 cubic feet per gallon, while ordinary practice has shown an actual requirement of 1½ cubic feet or more—30 times the theoretical. A further apparent drawback to the system is the necessity of re-activating a portion of the withdrawn sludge and returning it to the fresh sewage feed in order to continue the biological cultivation necessary for satisfactory aerobic digestion of the impurities.

"The idea was conceived that an aeration unit could be designed to effect self-contained sludge circulation and prolonged contact by utilizing the full mechanical efficiency of the escaping air bubbles in the form of an air lift."

Other features were developed which warranted the adoption of a distinct name for the modified process, which has been designated the "Dorr-Peck" process.

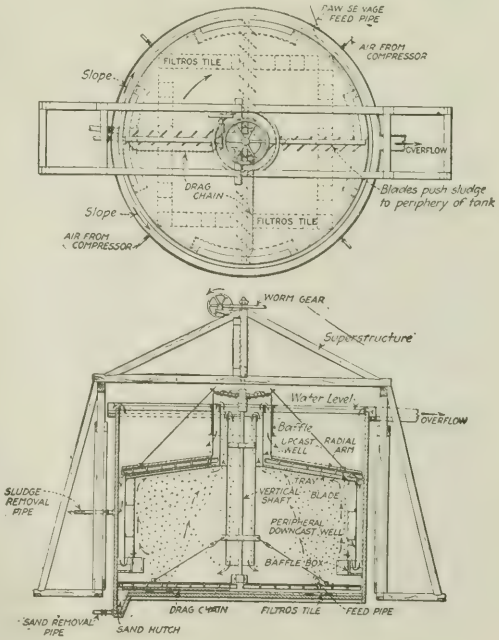
In the experimental plant the sewage first passed through a Dorrco screen of the drum type which was described in the September 27, 1919, issue of "Municipal Journal." The average removal of suspended solids by this screen was 12.2 per cent. The action of the screen resulted in breaking up most of the soft solids, which were easily digested in the subsequent activating units, this not including tough and non-digestible solids. This permitted the nitrogenous matter to pass on to the activating tank and excluded from it the non-nitrogenous matter.

The screened sewage passed to two aeration-sedimentation units operating in series and constructed as shown in the illustration. The sewage was delivered at the top of the central down-cast well and was instantly mixed with 20 times its volume of freshly activated mixture containing a high concentration of activated sludge solids which were brought up from the aerating chamber and delivered at the surface from the throat of the air lift formed by the constricted annular well surrounding the central down-cast well.

The cycle consists of a rapid elevation of the activated mixture from the aerating chamber to the surface, receiving the small proportion of fresh sewage, and a quick passage down again by way of the central down-cast well. This action tends to rapid aerobic digestion by actual dilution with the effective medium. There is a continuous displacement from the circuit of a volume equal to the fresh feed, and this is pushed over into the outside annular well, which acts as a feed baffle and distributor. Thence it flows to the quiescent sedimentation chamber in the upper portion of the tank. The effluent overflows around the periphery of this chamber, the solids settling to the tray bottom where they are mechanically pushed to the peripheral down-cast wells, dropping through to the aeration chamber and entering the circuit again. A small portion of the fresh sewage accompanies the feed to the sedimentation chamber without having passed around the circuit for proper aerobic treatment and for this reason the effluent is passed through a duplicate unit where the cycle is identical with that of the first unit except that 75 per cent of the oxidation or activation having been effected in the first unit, a correspondingly reduced amount of air is supplied to the second unit.

In order to secure a supply of biologic sludge in the second unit to complete the purification, no sludge is withdrawn from the first unit, but it is allowed to build up in the sedimentation chamber and overflow with the partly purified liquor. The only point of sludge withdrawal is from the tray bottom of the second sedimentation chamber, where it is withdrawn as required to keep it from building up and overflowing with the finally purified effluent.

"The average air requirement was 0.6 cubic feet per gallon of sewage treated, maintained uni-



THE DORR-PECKACTIVE ATED SLUDGE TANK

formly over a period of two months. The detention period through the system ranged from eight to ten hours. A clear, colorless effluent was produced, containing less than 20 p. p. m. of suspended solids, up to 1 p. p. m. of nitrate and nitrite nitrogen, and was stable at least six days to the methylene blue reaction at room temperature. A 90 per cent removal of bacteria was effected, and the oxygen-consuming power was reduced 80 per cent. The sludge contained 7 to 9 per cent of nitrogen, on dry basis, expressed as ammonia.

"The sewage treated was fresh domestic sewage of the following average composition:

Total solids, 596 parts per million.
Suspended solids, 245 parts per million.
Dissolved solids, 351 parts per million.
Alkalinity, 265 parts per million.
Oxygen-consuming power, 154 parts per million.

"The average flow treated was 45,000 gallons per day. The two aeration-sedimentation units consisted of cylindrical wood tanks, each 12 feet in diameter by 11 feet deep, combined capacity 17,600 gallons. Each tank was equipped with a Dorr tray thickener mechanism, the lower arms being equipped with squeegees to move any heavy grit to a peripheral sand hutch, for removal as required. The upper set of arms swept the surface of the tray bottom of the sedimentation compartment, moving the sludge to the peripheral downcast wells for re-circulation, and preventing accumulations of septic masses. In the case of the second unit, the squeezing effect of the plows tended to de-water the sludge to ultimate density for final withdrawal. The thickest sludge removed, however, contained 98.5 per cent moisture, due chiefly to the small size of the unit which transmitted slight disturbances, interfering with the normal de-watering operation.

"The air was supplied by a Nash hydroturbine compressor, and was measured by the Rotary Meter Company's compensating meter, which is so designed as to compensate for any air pressure applied, registering only the actual amount of free air passed. The meter was frequently checked by mercury manometer readings through an orifice, and found accurate. The sewage flow through the plant was recorded over a 90 degree V-notch weir, by a Foxboro recording depth gage.

"Filtros tile (Grade E) was used as a diffusing medium, with satisfactory results. No measurable building-up of pressure through clogging was registered during the five months' period of operation. Furthermore, the air supplied by the Nash compressor is quite free from dust, due to a water-washing action which is a part of its operation.

"The results are gratifying, and indicate a marked advance in the treatment of sewage by aerobic methods. It is realized that they are not conclusive, by reason of the fact that the local conditions at Mt. Vernon might not obtain in another locality, although the analysis indicates a strong municipal sewage.

"An experimental Dorr-Peck plant on a 200,000-gallon daily basis is now in operation at Urbana, Ill., under the direction of the Illinois State Water Survey Division. This experimental work was started under the supervision of Col. Edward Bartow. The Corn Products Refining Company is also installing a small experimental unit at its Argo plant, to test its efficiency as compared with other methods. This plant will operate chiefly on the factory waste waters. The experimental work will be directed by the staff of the Sanitary District of Chicago."

Determination of Pump Efficiency

A handy rule for computing the efficiencies of pumps for waterworks and other services is given, as follows, by the Blake Pump and Condensor Co., Fitchburg, Mass.:

The efficiency of any pump is determined by the relation of the amount of power applied to the amount delivered by it.

For example: 100 horse power is being consumed by a pump which is delivering 500 G. P. M. at 225 lbs. pressure. This duty is the equivalent of but approximately 65 horse power. Therefore, the amount of power absorbed in the pump by friction of operating parts, fluid, etc., is 35 horse power. This can be termed "Wasted Power" and in this case is excessive by about 25 horse power.

Perfect, or 100 per cent efficiency, is impossible, but proper designing, the use of first quality materials, careful workmanship and skilful operation will produce efficiencies within the range of 85 to 92 per cent, depending upon conditions.

The following is a simple method of computing pumping efficiencies:

$$\text{H. P. Consumed} - \frac{\text{Gals. per Min.} \times \text{Pressure}}{1710 \text{ (constant)}} = \text{Wasted Power}$$

If the wasted power does not lie within the range of 8 to 15 per cent of the total power cost it is not high efficiency.

Ranger's Water Supply

A permanent supply of water for the rapidly growing town of Ranger, Texas, has been one of the aims of the chamber of commerce of that city since its organization. The present supply is taken from a lake which receives the drainage from a considerable part of the city and has never been offered for drinking purposes, but only for manufacturing and fire protection. John D. Hawley was retained by the chamber of commerce and has reported on a supply to be derived from a point 9 miles east of the city, where a dam 1,600 feet long with a maximum height of 50 feet above bed rock would impound 1,500,000,000 gallons. There would be a 16-inch main line leading to the city, a filtration plant, pumping plant and standpipe. The estimated cost would be about $700,000. The chamber of commerce is considering the subject of financing the project, including the taking over of the distribution system and equipment of the local water company.

PUBLIC WORKS

Published Weekly
by
Municipal Journal and Engineer, Inc
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates

United States and Possessions, Mexico and Cuba .. $3.00 per year
All other countries ..... $4.00 per year

Change of Address

Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

A. PRESCOTT FOWELL, Editor
FRANK W. SKINNER, Associate Editor

CONTENTS

DIFFICULT SWAMP ROAD CONSTRUCTION—Illustrated 49
Road Builders' Truck Turntable 50
WATER WORKS NOTES IN EUROPE 51
FLOOD CONTROL BY SMALL DAMS 51
TREATING SEWAGE BY THE DORR SYSTEM—Illustrated 52
Determination of Pump Efficiency 56
Ranger's Water Supply 56
EDITORIAL NOTES 57
Building Investigation—Points Overlooked
OBSTACLES TO CONSTRUCTION OPERATIONS 58
More Paving Bids Received 59
Buffalo's Improved Water Supply 59
North Carolina Highway Construction 60
SNOW REMOVAL FROM COUNTRY ROADS—Illustrated 60
PRESERVATIVE TREATMENT OF WOOD POLES 63
Galveston's Sea Wall 63
Wire Rope Fastenings 64
El Paso Irrigation Project 64
HOW CAN SUBMERGED WATER PIPES BE INSTALLED? 65
Rapid Road Concreting—Illustrated 67

Building Investigations

Some of the reasons why construction, especially that of buildings, has responded so slowly to the general improvements in the industrial and commercial situation, are being rapidly demonstrated by the investigations in New York of the Lockwood Senate Committee, which have disclosed a very serious local condition that there is good reason to believe is closely paralleled in other parts of the country.

It shows that three of the four principal factors in construction—labor, material and supply dealers, and contractors—are all to blame, and it may yet show that the fourth factor, capital, is not guiltless. While commencing with the individual heads of limited labor organizations where atrocious conditions were disclosed, it has neglected the more general field of labor union principles and policies, but has very effectively ventilated and attacked the conspiracies and unlawful combinations of important manufacturers, dealers and contractors themselves. In all of these three directions as well as with capital, the investigation should be most thorough and impartial and all misdoings should be exposed and punished and measures taken to prevent their recurrence.

More weight should, however, be given to the initial responsibility and the prime causes in many of these evils. A large proportion of the trouble started in the labor policies and its growth was possible only through the action of the labor leaders who have been permitted to enforce their arrogant and unjust demands so long that eventually the manufacturers and contractors were obliged to fight the devil with fire, with the natural result that in some cases equity has been forgotten and both sides have combined to rob the public outrageously.

Much credit should be awarded for the remarkable results secured by the committee, which, in only ten weeks' investigation, has already exposed thirty pernicious trade combinations, of which seven have been dissolved, and have eighteen more under investigation. It has secured one hundred and twenty-four indictments against individuals and firms and many more are to follow that together will require the entire efforts of four special grand juries.

The notorious head of the Building Trade's Council and his associates, several other labor union officials, representatives of commercial organizations, besides contractors, employers and others, have been indicted and more are to follow. Wherever conspiracy, intimidation or corruption can be proven they should be mercilessly punished and the investigation commended by all good citizens.

Points Overlooked

The enumeration in this issue of the principal obstacles to construction prosperity in this country omitted two important elements. The first is the very great delay, damage and uncertainty caused by inefficient transportation and by the strikes in public necessities and utilities, like the railroad switchmen, engineers, the tugboat crews, longshoremen, steel workers, truckmen, and coal miners, deliberately and avowedly intended to paralyze national activities.

The other point which affects not only construction but every phase of public welfare is the policy which has been, by every possible means, to conspicuously exempt from the war burden the largest part of the citizenry, namely the working classes, whose wages were raised to extravagant, disproportionate and wholly unnecessary amounts as fast as, or faster than, the cost of living increased.

This encouraged idleness, extravagance, inefficiency and discontent as excessive wages always do. It established government standards at fixed general prices and not only exempted practically all labor from even indirect taxation, but, in multiplying laborers' incomes at the same rate as their expenses or a higher one, multiplied also the

difference between them, thus giving them higher profits at the expense of all other citizens, especially those with any form of invested capital or in professional, intellectual and most skilled pursuits.

Obstacles to Construction Operations

Practical discussion by a general contractor and builder who emphasizes the great power of the hoisting engineers' union and the refusal of quotations by dealers in supplies, condemns the cost-plus form of contract, and recommends competitive bids and proposes cost investigation and price fixing by state and federal engineering commissions.

New York City, January 6, 1921.

Editor of PUBLIC WORKS.

Dear Sir:

As a general contractor and builder for more than twenty years in New York and throughout the United States, constantly in contact with the various unions and their delegates, I have watched carefully their methods especially during the last ten years. Having also noted the actions of the Lockwood Committee, and the trouble conditions, hold-ups and extravagance that have been going on for several years, I want to give you my views on the cause and remedy for the present serious conditions in order that you may get them before anybody interested and the public in general.

REASONS FOR INADEQUATE CONSTRUCTION

These conditions are, in my opinion, due solely to the outrageously high cost of building that has increasingly deterred capital, ruined small contractors and laid a frightful burden on the public. This high cost is attributable directly to three great causes—the high cost of labor, the attitude of large contractors, and conspiracy and extortion of the union labor leaders; and to three other important general factors—high cost of materials, policy of manufacturers and dealers, and the cost-plus form of contract.

Of these, the Lockwood Committee has so far investigated only three; a minor phase of the labor element, the high cost of materials, and the policy of manufacturers and dealers; which serious as they are, are not the chief or the controlling features.

LABOR'S RESPONSIBILITY

The heart of the matter is the high cost of labor which, directly or indirectly, represents four-fifths of the cost of construction, which cannot have a low price while labor has a high price. So long as the general public is hypnotized to bleat for maintaining "high living standards," and unabated wages demanded by the labor demagogues and politicians, and while many contractors themselves have profited by the exorbitant wages, the latter will continue, even with reduced construction. When the public demands lower wages and really wants them, they will come.

Throughout the country the hoisting engineers, who handle all materials for every kind of construction, hold the key of the situation and do not hesitate to use it. They alone are sufficient to control every important job and are more powerful and more mischievous than the unions that already have been investigated. In New York they are thoroughly endorsed by the enforcement of police regulations framed in their behalf so as to make it practically impossible for outsiders to supply a shortage of hoisting engineers in this city.

COST OF MATERIALS CAN BE GREATLY REDUCED

The high price of materials is due directly to the high cost of labor, profiteering, uncertain transportation, and under-production. The present senate investigation should be of some value in exposing conspiracies and violations of the law, but so far has shown no disposition to adequately investigate or reduce the high cost of labor.

Profiteering could be curbed, if not eliminated, by the appointment in every state of a commission, headed by experienced engineers, with jurisdiction to investigate the production, sale and distribution of all kinds of materials, to determine the cost and reasonable profits and prices and with authority to enforce their decisions. These state commissions should be co-ordinated under Federal supervision, which should be thoroughly competent and honest and uninfluenced by politics, by labor, or by manufacturers.

PERNICIOUS TYPE OF CONTRACT

The cost-plus percentage form of contract encourages rather than discourages high prices and high costs of all kinds connected with building construction. While it expedited and simplified some of the very urgent construction necessary in the war emergency, and could then be accepted as one of the sacrifices that patriotic citizens were prepared to make for the safety of the nation, the excuse for its existence in 95 per cent of present and future contracts has passed, and it should be eliminated, despite the protests and arguments of some contractors who have profited unduly by it and find in it a sure cure for all business risks, a relief from careful estimating and planning, and a way to secure assured profits, increasing with the cost of the work.

The attitude of some large contractors is, as some of them openly express it in a slogan, that they are "builders, not bidders," that they do not compete in the proper sense of the word; that they take no interest in the reduction of cost because the owner must ultimately pay it in any event; and because, in most of the important work at present under construction, the more expensive the job, the greater the contractor's profit.

COMPETITION AND EFFICIENCY INDISPENSIBLE

Construction work should be on a truly competitive basis, and if a contractor's experience,

ability, resources and ingenuity do not enable him to work profitably on it, he should not be in the construction business. The cost-plus percentage contract puts a heavy premium on extravagance of all kinds, on paying the highest possible price for labor and materials, on doing the work slowly, on the use of unnecessary plant and equipment, and on charging it with unnecessary burdens.

If contracts are not awarded for a lump sum, or for unit prices that often may and even should be adjusted by a sliding scale, they should be executed under rigid supervision for actual necessary cost plus a fixed fee, equivalent to paying for superintendence merely, or on a lump sum basis with a profit and loss sharing arrangement by which the contractor shares both expense and savings on either side of a predetermined and accepted working estimate.

DESTRUCTIVE POLICY OF LABOR UNIONS

The conspiracies and extortions of union labor leaders, who have absolute and unlimited control of labor organizations, are due to the tremendous amount of graft, easy money and other kinds of profiteering that the organizations provide. Their treasuries contain many, many millions of dollars that keep the agitators in soft berths and afford rich pickings to the leaders.

The unlimited power of the leaders enables them to dictate the most oppressive and humiliating terms to employers, to call strikes on any pretext or on none, to impose and collect extortionate fines from owners for infringement of arbitrary union rules. It limits the production and efficiency of the men, and by excluding non-union or non-local workers, creates an artificial shortage of labor.

CONSTRUCTION IN SPITE OF UNNECESSARY COSTS

Labor conditions are such, prices are so unnecessarily high, and fluctuations are so great, that it is dangerous to make bids at reasonable figures, and very difficult to fulfill the contracts when they are awarded. There is in New York and some other places a considerable amount of building construction in progress for owners who are extravagant or who, for pressing business considerations, are willing to disregard outrageous demands to prevent interruption of the work, as in the case of the Cunard building on lower Broadway, where, it has been brought out by the investigation of the Lockwood Committee, hundreds of thousands of dollars were paid.

This class of work and a large amount of various kinds of Federal, state and municipal construction demanded by the public for the purpose of affording employment, will be carried on during the present year, but without some important changes in present conditions, ordinary construction, especially the building of at least 1,000,000 homes at a minimum cost of four to six billion dollars, will make little headway until conditions reach a crisis that may bring violent changes.

Wages are high or low according to the proficiency and production they command. The present scale is due to the government's yielding to labor's demands, to the profiteering and graft of labor leaders, to the municipal, state and Federal requirements for paying the "prevailing rate," paying percentages of profit on pay rolls, to the scarcity of skilled and unskilled labor and to the inefficiency of labor.

PIRATICAL DEALERS

The extortionate demands of some manufacturers and dealers, increased by the contractors' percentages, have been passed on to the public, who have to pay huge prices for small quantities and even for inferior qualities. Some dealers have also refused quotations necessary for making estimates, so that contractors must either bid very high for reasonable protection, thus losing the work, or bid low to secure it and then be in danger of heavy losses on their purchasing.

At present, or very recently, it has been impossible for contractors in this part of the country to purchase any more material than is needed for the specific job, or to secure any quotations whatever for future deliveries, even within strictly limited time, for brick, cement, sand, stone, lime or plaster, and probably for some other important commodities. This for about a year has been one of the worst features responsible for the slump in construction work.

With open markets and lower prices based on actual values and efficient methods both for materials and labor, with a real and general determination to bring down the price of construction labor to at least the same proportion as is already being accomplished in shops and factories and with a proper form of contract, there is no reason why construction and building should not rapidly attain and long maintain unprecedented volume and prosperity in this country.

Yours truly,
DENNIS E. CONNERS.

More Paving Bids Received

The State Highway Commission of New Jersey received evidence on December 1 of improved conditions so far as securing highway contracts is concerned, having received upon that date twelve bids for grading the Ancora-Atco section of Route No. 3. The contract was awarded to the Weldon Construction Co. of Westfield for $56,883.90. The highest bid was $128,903.85, or more than twice as great.

Buffalo's Improved Water Supply

Tests of the water supply of Buffalo, N. Y., from the point of view of fire protection were made in 1916 by the National Board of Fire Underwriters, which found that "only about 25 per cent of the water required for good protection was available in much of the congested business section." Under date of December 30, 1920, the board publishes a special report in which it says that "the protection available from the public water supply to the congested value district . . . has been so improved that it now meets the full requirements." Part of the gain is due to reduction of waste by metering and extensive cleaning of mains.

North Carolina Highway Construction

Wythe M. Peyton, state highway division engineer for the mountain district, division No. 1, North Carolina, reports that a total of 30.84 miles of the 487.28 miles of good roads planned has been constructed during the past 12 months. The estimated cost of construction is placed by the engineer at $6,621,822.57. To show the increase in activity in the highway division, Mr. Peyton quotes the fact that whereas in June, 1919, the work included only one division engineer, one stenographer and one survey party of five men, there are now all told one division engineer in charge, one assistant engineer in charge of location work, one in charge of construction work, one stenographer and seven survey parties of seven men each, together with eight inspectors on concrete and asphalt construction.

Snow Removal from Country Roads

Methods employed last winter and adopted for this one in Pennsylvania, Indiana, Michigan, Illinois, New Jersey, Massachusetts, Connecticut, Maryland and New York. Preventive methods, including snow fences. Methods of handling snow.

Last week we discussed the removal of snow from city streets, and until within a few years past little snow removal work was done outside of the cities. With the enormous development of automobile traffic, and especially of trucking and other commercial traffic, the importance of keeping at least the main highways open has been generally realized throughout the country. For instance, during the year 1919 the daily tonnage carried over a section of the highway between New York and Philadelphia averaged 2,503 tons in the spring, 2,129 in the summer, and 2,092 in the winter; the average for the year was 2,391, and the winter traffic was only 12 per cent less than the average. The following information concerning removing snow from highways is abstracted from a summary of the present practice in the numerous states by J. L. Harrison, senior highway engineer of the Bureau of Public Roads, in a recent issue of the publication of the bureau.

Pennsylvania has led in the matter of snow removal and expects to do more this winter than ever before. The state has equipped 75 additional trucks with snow plows and is increasing its other mechanical facilities and its snow removal organization. The state is mountainous, it is traversed by several very important through highways and the snowfall is heavy. More snow fences are used in the state than anywhere else in the country and this has done much to prevent the drifting of snow across the roads.

In the equipment there is no feature differentiating Pennsylvania from the other states except that the percentage of V-shaped plows is greater. Perhaps its most distinctive feature is that, because the right of way is kept scrupulously clear of weeds, brush, etc., obstructions of all sorts are removed wherever possible and snow fences are used liberally, the cost of keeping the roads clear is as low as $50 to $200 per mile.

Perhaps the most important and unusual feature of Pennsylvania's snow removal program is its co-operative arrangement with the weather bureau by which the highway department is informed in advance of the approach of storms. This information is at once sent by the department to its field engineers and they arrange in advance of the storm for the necessary amount of machinery and men to fight it. In the case of a storm lasting several days it is of the utmost importance that the snow fighting be continuous until the storm has passed, since a few hours' cessation might so block the road as to prevent the use of snow plows and other snow removal appliances. In a severe storm a crew can be depended upon for only a limited period before resting and therefore it is absolutely essential that reserve forces be on hand to keep up the fight; and special emphasis is placed by the department upon this feature of the snow fighting. If any point on the main routes is blocked for more than 24 hours, a flying squadron of men and equipment is sent from headquarters and men are drafted from other near-by sections until the regular men and equipment on the section in question are able to cope with the situation.

Ohio. In Ohio the responsibility for snow removal rests with the counties, towns and townships, but the state highway department publishes valuable instructions and sends its engineers to advise and assist when requested. There is to be a definite effort to keep open the important routes through the state this winter, but as the state has no legal powers in the matter it is not yet certain just how completely this plan can be carried out.

Indiana. In Indiana the state highway department has ample funds and full authority for snow removal, but this has never before been undertaken on a large scale and, generally speaking, the snowfall in the state is not heavy enough to cause much obstruction of traffic. It is believed that no definite plans have been made by the department for handling this winter's snowfall.

Michigan. The state highway commission of Michigan did a good deal of snow removal work

last winter and is planning a more extensive program for this one, expecting to keep all the state routes open. In the north, where the snowfall is heavy and the traffic light, the snow will be rolled, but further south plows will be used. During the fall, obstructions were cleared from the right of way, tight fences and hedges removed, snow fences installed, and machinery prepared for action.

Illinois. In Illinois the state highway department has maintenance control over only those sections of the state system on which paving has been completed, and at present this includes only two important routes, from Chicago north to Wisconsin and from Chicago to Clinton. However, only about once in three years is the snowfall heavy enough to obstruct traffic, and even then only when it drifts. Moreover, there are few cuts on the two routes named. However, the department has plenty of snow removal equipment should it be needed.

New Jersey. During the winter of 1919-1920, the state department of New Jersey kept 280 miles of highway clear at an expense of $77,710, or an average of $278 per mile. The actual cost varied largely, however, one short stretch on the main road between New York and Philadelphia having cost $4,327 during February alone, in this case ice as well as snow having to be removed and the drainage conditions being unfavorable. This winter it is planned to keep open the entire 700 miles of state highway department routes. Some snow fences will be used.

In this state it is customary to start clearing on a width of 30 feet or as near that as possible. The plows are ordered out as soon as 2 or 3 inches of snow has fallen and are worked 24 hours a day while the snowfall continues. As successive storms are plowed back from the road the open space gradually narrows, but is not permitted to become less than 18 feet.

Massachusetts. In this state private interests are looked to to a very large extent for keeping open the roads, the highway department having only $50,000 available which will be used chiefly for a general supervision. In this state the main highways are used very extensively by manufacturing interests for transportation of raw materials and partially manufactured products and the highway department endeavors to secure a cooperative agreement between the manufacturing companies, large trucking companies and the cities and towns. The state will supply snow plows, while the trucks and men are expected to be furnished by the private and public corporations interested in having the roads kept open. It will be interesting to see from this winter's experience how this plan will work out.

Connecticut. The Connecticut state highway department removes snow from the state highways, obtaining the necessary funds from automobile license fees. Sufficient equipment is available for ordinary snowfalls. Last year's snow was removed from about 1,000 miles of road. No changes from last winter's program was anticipated.

Maryland. In this state the snow problem is not serious except in the mountains of the western section. Here, however, the snowfall is heavy and lasts until late spring. No attempt has been made to keep the roads open heretofore, but this winter the roads commission is planning to keep open the roads from Washington through Baltimore to the Delaware line, from Baltimore to Cumberland and western Maryland, from Baltimore to Annapolis and to Solomon's Island and Point Lookout. At least 20 4-wheel-drive trucks are equipped with plows for this purpose.

New York. In this state the law places the responsibility for snow removal on the local authorities and so far it has seemed impossible to devise any method for state control of snow removal.

SNOW PREVENTION METHODS

Methods of handling the snow problem are generally classified as snow removal and snow preventive methods.

Preventive Methods. The greatest difficulties and expenses in snow fighting are caused by drifting. Snow drifts are formed on the lee side of obstructions. Prevention of the formation of drifts begins with the removal from the right of way of anything that may cause drifts. A growth of weeds or grass of not more than a foot or two high causes drifting when the wind is right, and more drifting is caused by weeds and brush allowed to accumulate along the roadway than in any other way. Hedges are next in importance and these should be removed wherever experience has shown that they cause trouble. In many regions the winds that carry snow are so uniformly from one direction that only a relatively small fraction of the hedges need to be removed. Stone fences, rail fences, picket fences and all tight fences often cause drifts, and these should be taken out and wire fences substituted. Where rows of trees cause drifts to form it will generally suffice to trim the branches well up from the ground, although sometimes the entire tree must be removed. Where removal of trees, hedges, etc., conflicts with roadside beautification and home and town improvement, it may be that the removal of them will cause more trouble of another kind than the removal of snow which was occasioned, and good judgment must, of course, be used in the matter.

In addition to the above, drifting may be caused by the topography of the country, such as a hill that affects the air currents or a cut so placed that it catches flying snow. Under such conditions a good deal can be done by erecting snow fences. These should be so placed as to cause the deposit of snow on the lee side of them before it reaches the road. The fences are therefore placed from 50 to 60 feet from the road on the windward side. They may be either permanent or portable, but the latter are generally preferable, for they can be set up on farm lands after the crops have been removed, and removed in time for the spring plowing.

Snow fences are generally of either the board

fence type or the picket type. The former as designed by the Ohio state highway department, is shown in the accompanying illustration. The portable board fence differs from the permanent installation only in that it is made up in sections of convenient length and held in place by stakes rather than by set posts. Picket fences are often used for portable ones, the best one being of light pickets held in place by a number of strands of heavy wire. These can be attached readily to driven posts and when not in use can be rolled up and stored away.

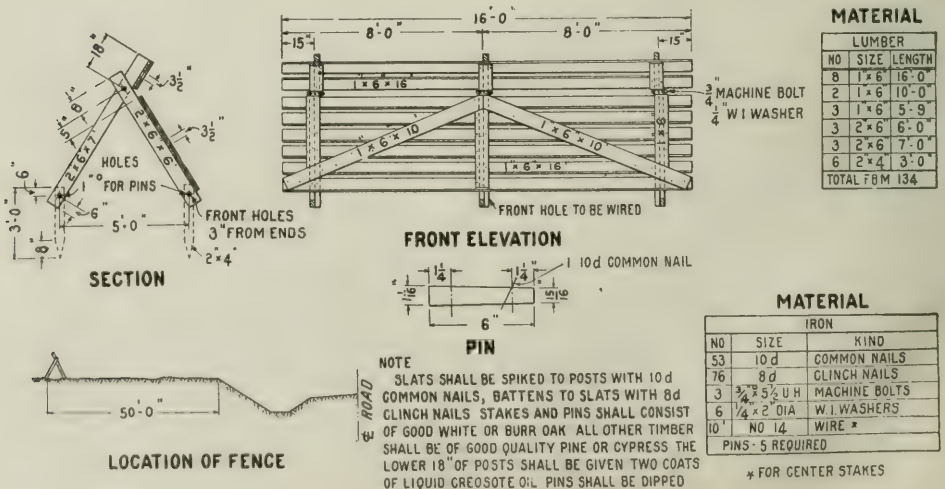
REMOVING SNOW

There are only two methods of keeping roads open to traffic where snowfall is heavy—compacting it and removing it. The former serves the purpose where traffic is light and consists principally of horse-drawn vehicles and a few light automobiles. But it is wholly unsatisfactory where many automobiles or heavy trucks use the highway, for these are apt to become stalled, and also ruts are formed and the road surface at the bottom of them seriously damaged. Snow is compacted by rolling it after every snowfall with a roller 6 or 8 feet in diameter and 10 to 12 feet long, with the ends closed. (See "Municipal Journal" for February 8, 1919.)

Snow may be removed by plows or by hand. Rotary plows have been used but are not common in this country. Ultimately, however, Mr. Harrison believes that the heavier snowfalls will be handled by some form of apparatus resembling the modern elevator grader. Such a machine might clear the full width of the highway at a single cut and by using a fast-moving belt discharge the snow well away from the line of travel and where it would tend to prevent further drifting. The present practice, however, is to push the snow to one side by means of blades. Road graders may be used, but the most common practice is to fasten a heavy blade ahead of a heavy truck. Sometimes when the snow is deep a second truck is hitched ahead of that carrying the plow.

The snow may be moved from the center to both sides, but in order to prevent drifting it is better to remove all of the snow to the leeward side of the road. Even then some drifting may result, but much less than if the snow were piled on the windward side. The first clearing should be at least 10 feet wider than the traveled way, this extra space being used for receiving the later snowfalls as they are pushed aside. Success in this work consists in getting the plows onto the job early enough and keeping them at work continuously. A well-driven truck can handle about 10 miles of highway. One and preferably two assistants should accompany the driver. If a heavy blanket of snow is being removed, half a dozen men with shovels should go out with the truck. Under normal conditions a truck should make one cut an hour, but as it takes four full cuts to clear the necessary width at the beginning of the season and generally three during the later months, the truck at each cut will have 4 hours' deposit of snow to remove. But if it is started early and kept running continuously it will not often happen that other methods have to be resorted to.

However, if drifts have formed it will often be impossible to find space to store the snow that must be plowed out if the cuts are to be kept clear. Under such conditions the usual method is to have men with shovels clear away the drift by hand. This kind of work is expensive, but points where drifts form are those where the greatest width of cut is needed to permit the plows to operate to advantage, and they must be cleared to sufficient width or otherwise they will



MATERIAL

LUMBER		
NO	SIZE	LENGTH
8	1"x6"	16'-0"
2	1"x6"	10'-0"
3	1"x6"	5'-9"
3	2"x6"	6'-0"
3	2"x6"	7'-0"
6	2"x4"	3'-0"
TOTAL F.B.M. 134		

MATERIAL

IRON		
NO	SIZE	KIND
53	10d	COMMON NAILS
76	8d	CLINCH NAILS
3	¾"x5½" U.H.	MACHINE BOLTS
6	¼"x2" DIA.	W.I. WASHERS
10'	NO 14	WIRE *
PINS - 5 REQUIRED		

* FOR CENTER STAKES

NOTE

SLATS SHALL BE SPIKED TO POSTS WITH 10d COMMON NAILS, BATTENS TO SLATS WITH 8d CLINCH NAILS. STAKES AND PINS SHALL CONSIST OF GOOD WHITE OR BURR OAK. ALL OTHER TIMBER SHALL BE OF GOOD QUALITY PINE OR CYPRESS. THE LOWER 18" OF POSTS SHALL BE GIVEN TWO COATS OF LIQUID CREOSOTE OIL. PINS SHALL BE DIPPED IN CREOSOTE OIL

PORTABLE SNOW FENCE DESIGNED BY THE OHIO STATE HIGHWAY DEPARTMENT

be blocked at once with every snowfall and hand shoveling must be used almost exclusively in them.

For hand removal it is important to use large scoops. Even at some additional first cost, the snow must be so piled that it will hinder rather than assist the re-filling of locations that have been cleared. Where the cuts are both wide and deep it may be cheaper to load the snow in trucks and remove it entirely, but this is not generally advisable. Rotary snow plows would be of especial advantage in these deep drifts and, although they have not yet come into very general use, it is thought that such use is bound to increase. "Just how rapidly this change in snow removal equipment will be made will depend upon the development of satisfactory rotary plows, but it can hardly be put off much longer, for the cost of shoveling out deep drifts is very expensive." A plow of this kind was illustrated and described in PUBLIC WORKS for April 24, 1920.

Preservative Treatment of Wood Poles

Causes of deterioration, methods of prevention and economies of pole treatment. Coal tar derivatives used.

Under the above title a circular has been issued by Purdue University in an effort to answer quite fully a number of requests for information on this subject which the School of Engineering has received. While most of the practices, experiences and specifications drawn upon are those of private telegraph and telephone companies, municipal and other public works officials are interested in the permanance of poles used for carrying wires along streets and highways.

The pamphlet treats the subject quite exhaustively, devoting 51 pages of text and four pages of index to the matter. It describes the causes of deterioration of poles and methods employed for prevention, including the use of coal tar and other preservatives; treating poles by means of brush, spraying, pouring, open tar dipping and open tar hot and cold bath, together with the preparation of the poles for treatment. It also describes the economics of pole treatment and method of preserving poles already in service. It describes the results of inspections made of treated and untreated poles in Indiana, cites experiences in other locations, quotes specifications employed by the American Railway Engineering Association, the National Electric Light Association, the United States Shipping Board Emergency Fleet Corporation and the American Telephone and Telegraph Co.

It gives a summary and conclusions of the results of the study made of the subject, which summary is as follows:

1. A survey of the state of Indiana was made and showed that a considerable percentage of the poles erected at the present time are receiving some kind of treatment. The majority of pole-using companies are either using preservative treatment or planning to use it on future work.

2. The most commonly used preservatives in this country are derivatives of coal tar. Dead oil of coal tar or creosote oil and the higher boiling oils known as carbolineums are the most satisfactory preservatives. Coal tar itself should not be used as it has little value as a preservative, and "mixed creosote oils," those containing undistilled products, cannot be recommended.

3. The commonly used treatments in Indiana are the brush treatment and the open tank treatments either by dipping or by the hot and cold process. Poles of less durable woods treated by the pressure tank process are as yet more expensive than butt treated cedar and chestnut poles and so have not come into extensive use.

4. A study of the economic side of pole preservation shows that under average conditions an increase in life of about 2 years will justify brush treatment, about 3.5 years will justify the open tank dipping treatment in hot creosote and about 7.5 years will justify the hot and cold bath open tank treatment. The results of the inspections made in various parts of Indiana, indicate that an increase in life greater than that necessary to justify the treatment may be expected for these treatments if they are applied properly.

5. It is possible to increase the life of poles already in service to some extent by reinforcement and treatment after setting. The most commonly used method is the process of reinforcing by setting a creosoted stub along side the weakened pole and binding the two together by wire. Another method used is that of excavating the earth from around the pole, clearing away decayed wood and applying a brush treatment. Concrete reinforcement has been applied to some extent but on account of the cost can be recommended only for exceptional cases where the cost of replacement of the poles is very large.

6. The selection of the proper method of treatment to be used depends upon local conditions. For the lighter lines and for the smaller companies, or where first cost is an important consideration the brush treatment offers some advantage. The open tank dipping process known as Specification "AA" is preferred by some on account of greater uniformity and probably somewhat longer life than the brush treatment which advantages are considered to overbalance the increased cost. The hot and cold bath open tank treatment gives the greatest increase in life and is particularly suitable for heavy lines and permanent construction.

Galveston's Sea Wall

Following the storm of 1900, which caused the overflowing of a large part of the city of Galveston, Texas, a sea wall about five miles long and 17 feet high above mean low tide, was built and completed in 1904 at a cost of slightly over $2,-

000,000. For some time past an extension of this sea wall has been under construction by the federal government, and it is predicted by Major L. M. Adams, the engineer in charge of the work, that this will be completed by August 1, 1922; 9,110 feet have already been constructed and about 1,200 feet remain to be built. Although the original wall about five miles long cost about $2,000,000, the two miles being built by the government will cost about $1,500,000, owing to the greatly increased cost of public works during the past few years.

Wire Rope Fastening

Wire rope attachments, made in the field, are seldom capable of developing the full strength of the rope; the common method of forming a loop eye with the loose end clamped to the standing part, although simple and rapid, is not very reliable, is likely to slip, is subject to injury by meddling and may not be more than 60 or 70 per cent efficient. Any fair mechanic can, without any special tools, secure a forged socket to the end of the rope that will provide a clevis or pin connection of full strength that once made is far more secure and easily and rapidly shifted than the clamped connection.

Reliable instructions for making wire rope attachments are given in a recent issue of the "Excavating Engineer," which says:

"The rope may be attached to its load by means of a socket, or it may be bent back on itself to form an eye and the loose end clamped to the rope with rope clips or clamps. Properly done, the former method of attachment develops the full strength of the rope, but it has several disadvantages.

"Poor workmanship is concealed, showing only when the rope slips or breaks in the socket; it cannot be readily inspected; the rope is rigidly held in the socket and the effect of bending is concentrated just above the socket; and it is much more difficult to make.

"The latter method, fastening by clips, develops at most only about 85 per cent of the strength of the rope, usually not more than 80 per cent. It bruises and crushes the rope where the clips are applied, and is liable to slip; but it can at all times be readily inspected and requires little skill in making. Rope makers, however, recommend the socket method of fastening, and if properly made it never fails. After either a socket or clamp attachment is made, it must always be tested by making several trips under a heavy load.

"The method of making the best socket joint is as follows: The rope should be securely seized or bound at the end with soft iron wire before the end of the rope is cut square. An additional seizing should be placed on the rope, a distance equal to the length of the socket from the end.

"After the rope is trimmed off, the seizing on the end of the rope should be taken off, the rope opened down to the second seizing, the hemp center cut out the wires broomed out. That is, they should all be untwisted but not straightened. Then the wires should be thoroughly cleaned in benzine, naptha or gasoline, as far as they are to be inserted in the socket, and then dipped in commercial muriatic acid for 30 to 60 seconds until the acid has cleaned each wire.

"Next, the rope end should be dipped in boiling water, to which a small amount of soda has been added, to clean off and neutralize the acid. Then the rope end is inserted in the socket and warmed if the temperature is below 65 degrees Fahrenheit, to prevent cooling the zinc too rapidly. The socket is placed with its axis vertical and coinciding with the axis of the rope, the bottom is sealed with clay or putty, and molten zinc or spelter, heated to a temperature that will just char wood, is poured into the socket until it is full. Lead or Babbitt cannot be used in this method because they will not solder the wires to the filling material as zinc will. Use only a good grade of zinc. Such a rope socket, attached carefully with good material, will hold and give nearly 100 per cent efficiency of the rope strength.

"Should it be impossible to obtain good zinc to make a socket fastening as described above, then the older method usually called 'loading of sockets,' is more reliable. In this case the wires of the rope are cleaned at the end as described above with the material on hand. Then the socket is pulled over the rope and every wire is bent back by means of pliers for 1 to 1½-inch length. Next the rope is pulled back into the socket and molten lead or Babbitt poured into the sockets. With this method we have no soldering effect between the wire and the filling metal and the wires are holding depending on the hook formed at their end. Naturally the wires will be distorted, subject to uneven tension at the end of the socket, reducing the efficiency of the joint."

El Paso Irrigation Project

Efforts are being made to utilize the full potential value for irrigation and power purposes of the Elephant Butte dam completed in 1916 at a cost of $10,000,000. At present 546 miles of irrigation canals have been built, sufficient to serve 115,000 acres of which last year 80,000 acres were irrigated and their value has increased to from $50 to $350 per acre.

It is now proposed to extend the project by the construction of a high-line canal to irrigate Palomas valley and Fort Hancock valley, and that another high-line concrete canal be built to divert all the water of the river at Leesburg, developing three water-power plants at the dam, at Tortugas and at Canutillo, with a total development of 33,000 h. p., the estimated cost of which is $4,000,000 and the estimated revenue $500,000 per year. The extension to the city of El Paso to furnish it with abundant power for all purposes will cost $1,000,000. The estimated value of the irrigation canal is $3,500,000, and its cost $2,250,000. It is proposed that if the government will pay for the cost of this canal, other interested parties will raise $5,000,000, thus providing for the entire construction and the full development of the water supply.

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems different will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one

How Can Submerged Water Pipes Be Installed?

Can be lowered from floats, from falsework, or from the ice. Can be hauled longitudinally on the bottom, can be laid with submerged cradle, floated to position and sunk, or sometimes laid in cofferdams.

Water mains frequently have to be laid under water for the crossings of rivers, inlets and harbors, and the installation of the submerged portions may present difficulty and unusual conditions to the contractor, even if he is familiar with ordinary pipe laying in land trenches.

The conditions and requirements vary so much in different jobs, depending on the type, diameter and length of pipe, the depth of water, character of the bottom and approaches, the location of the line, navigation, available facilities, and urgency of the work, that no universal instructions can be laid down, but it is possible to review a number of practical methods that have been found satisfactory under certain conditions and may be repeated or modified for similar or varying requirements.

For water of moderate depth and velocity and soft bottom, and where operations are not restricted by navigation requirements or danger from flood or storm, submerged pipes up to 10 or 12 inches in diameter and two or three hundred feet long, can usually be installed without serious difficulty or great additional expense, by any contractor competent to lay similar pipes on dry land.

Where the pipe is very much larger, or the conditions are more difficult, special methods and appliances may be required and careful precautions necessary and the work should be done by or under the supervision of a competent engineer or an experienced contractor who has previously specialized in similar submerged pipe-laying. Although riveted steel pipes, wooden stave pipes, or reinforced concrete pipes may be laid under water, their use for this purpose is comparatively infrequent and their dimensions are likely to be large so that their installation requires special skill and experience and will not be here considered. The pipes that are here considered will therefore be assumed to be of the commonest type, namely, cast iron pipes with lead caulked hub and spigot joints about 12 feet apart.

FOUNDATIONS

The pipe should be laid at a depth of one or more diameters below the surface of the bottom according to the character of the material on which it rests, but in very soft mud or silt it may require the construction of special foundations. These will usually consist of pairs of piles forming transverse bents with caps on which the pipe is supported. For small pipes the foundation piles may often be driven in pairs with their upper ends connected by caps or cross-pieces bolted on a little below the tops, the two piles being handled as a unit and their extensions above the cross-piece serving as guards to secure the pipe, which is lowered vertically to rest on the cross pieces. If necessary, the piles may be driven separately, cut off by a submerged circular saw, and capped by a diver who can also adjust and secure the pipe in position. Sometimes wooden saddles or pillows supported on gratings or mud sills are used instead of piles to support the pipe on soft bottom.

If there is only a thin layer of very soft material with harder bottom beneath, it may be permissible to allow the pipe to sink through the soft material by its own weight and become embedded in it on the harder material below without special foundation, or rock or other very hard bottom in shallow water may require to be drilled and blasted to provide a trench to receive the pipe. In deeper water where there is little or no current or danger from navigation it may suffice to lay the pipe on the bottom and cover it with a protection of clay, gravel or broken stone.

TRENCHING

In ordinary earth bottom the installation of the pipe should be preceded by the preparation of a full-length trench of the required depth which can generally be excavated by a drag line machine, by any available dredging machine, or by clam shell or orange peel buckets operated by a derrick boom and hoisting engine.

In some kinds of bottom the pipe can be laid on the surface and undermined from end to end by a hydraulic jet or suction pipe which scours out the material directly underneath and allows it to gradually sink to the required position. Such a method would require the special approval of the engineer in charge.

HAULING LONGITUDINALLY TO POSITION

Where the approaches to the ends of the submerged pipe are slopes tangent to it, a portion, at least, of the approach trench can be maintained

open at one end, the pipe can be assembled and the joints made in the trench on shore and the pipe hauled across the river in the previously prepared trench by means of a rope attached to it and operated by a windlass or hoisting engine on the opposite shore. All of the pipe may be assembled and jointed in the trench and hauled across at a single continuous operation, or one or more lengths may be assembled and jointed at the water's edge and pulled forward until the rear end is nearly submerged and another section or sections added and the whole again pulled forward, and so on. If all of the pipe is completely assembled on shore before hauling is commenced, it should be supported at each joint in cradles sliding on skids or supported on ways or rollers to facilitate its longitudinal movement.

Unless the pipe is very thin and light, the forward end should be plugged watertight to keep the interior dry and increase the buoyancy so as to reduce the submerged weight and friction of hauling. If the pipe is more than 12 inches more or less in diameter, the buoyancy of the enclosed air is greater than the weight of the pipe, thus producing a tendency to float which must be overcome by admitting a certain quantity of water to the pipe, or, in some cases where it is needed for other purposes, by enclosing the pipe in its concrete jacket. The forward end of the pipe should, in any case, be provided with a conical pilot and have proper attachments for the hauling line. The hauling will also be facilitated if two or three full-length longitudinal strips of wood are attached to the under side of the pipe to form runners that will diminish the friction on the river bed and prevent the bells or hubs from digging into the soft ground.

Except for very short lengths of pipe, special precautions must be taken to prevent the longitudinal tension of hauling from pulling the pipe apart at joints. The hauling line can be fastened to a continuous steel rod or timber lashed to each section of the pipe at the joint in such a way as to be detachable after the pipe is installed. Or collars can be put around the pipe at joints and connected by tension members adjusted to some initial strain and permanently left in position or removed after the pipe is installed if arrangements for this are provided. A very simple joint reinforcement can be made with three or four equidistant heavy longitudinal wires secured to lashings of smaller wire fastened at successive bells. These can be put under heavy initial tension by stressing with simple levers that can maintain the stress while the ends of the longitudinals are fastened to the lashings by finer pliable wire.

If the bottom is flat with gentle slope, ordinary joints with the necessary tension reinforcement may suffice, but if the bottom is irregular or if the alignment has any sharp vertical or horizontal bends, flexible joints must be provided. These can be secured by application of the ordinary Ward joint or some other type of ball-and-socket or adjustable connection at the required points.

LOWERED FROM FALSE WORK

Where the depth of the water is moderate and navigation does not have to be maintained, piles can be driven on both sides of the alignment and capped above the water to support the pipe assembled and jointed on it. Ropes or slings can be placed under the pipe at joints and connected to tackles suspended from the top of the falsework, the original supports removed, and the pipe lowered by slacking off the tackles slowly and with great uniformity at given signals. If the pipe is not too heavy, the tackles may be replaced by simple ropes, each passed two or three times around a beam or snubbing post with rounded corners. The loose ends of these ropes must be handled and the slack held by careful, reliable men who simultaneously pay out a small given amount on signal, thus gradually lowering the pipe to position.

If the work can be done when the water is covered with heavy, strong ice the pipe may be assembled and jointed on transverse sills laid on the surface of the ice in the plane of the alignment and when all is in readiness the ice can be broken through on longitudinal lines each side of the pipe and, the narrow detached strip of ice underneath it being removed, the pipe can be jacked up to release the original sills and transfer the weight to transverse timbers above the pipe, spanning the opening, and from which it can be lowered in the same manner as from falsework.

LOWERED FROM FLOATS

If the pipe is provided with flexible joints at intervals of not more than 100 or 150 feet, allowing it to be safely deflected to a considerable angle, it can be assembled on or between pairs of rafts, scows, pontoons or other floating platforms and the successive lengths can be lowered from them after the joints have been completed in the same manner as the pipe is lowered from falsework. Care is, of course, taken to always keep the forward end of the inclined portion of the pipe safely secured above the surface of the water and to maintain the floats with reliable moorings and protect them from navigation, drift and current so that they shall not be displaced and carry the pipe out of position.

FLOATED TO POSITION AND SUNK

A long line of small pipe may sometimes be advantageously assembled and jointed on blocking, sills, or launching ways just above the surface of the water, in a sheltered position. Pairs of empty oil barrels or other casks may be secured to do it with detachable connections and the pipe carefully launched by removing or lowering the support or by transverse movement of such a nature as not to cause serious friction or stresses. The pipe may then be towed to position and lowered in the vertical plane of its required alignment, sufficient water being admitted to make its specific gravity slightly greater than unity. It may be lowered by simultaneously or successively cutting the lashings to the floats. The lowering should be further safeguarded by

several pairs of suspension ropes, slings or hoisting tackles attached to it at intervals to prevent any displacement or irregularity.

PIPE LAYING WITH INCLINED CRADLE

Large, heavy pipes can be laid in deep water where obstructions to navigation are not permitted, by making all of the joints flexible and assembling the pipe lengths at the upper end of an inclined cradle or launching ways reaching from the working platform to the bottom of the river and gradually receiving it in advance as the pipe is laid from one shore to the other.

For deep water and heavy pipe the cradles become massive, trussed structures long enough to have an inclination of approximately 45 degrees. They are hinged to the boat, pontoon, or other float on which the pipe is assembled. The pontoon is securely moored in position and as each pipe length is added at the upper end it is moved backwards, allowing the lower end of the cradle to drag along on the bottom of the river and be pulled out from under the stationary pipe which drops to the bottom and adjusts itself to the irregularities as it is deposited there. This method requires exceptionally efficient joints that will not be injured by the considerable stresses of installation. A notable example of this successful operation was in the laying of several thousand feet of large pipe crossing the narrows from Long Island to Staten Island in water more than 60 feet deep.

No matter what the method of laying submerged pipe, if the joints are not of suitable character and well made they are likely to develop leaks due to the stresses of installation. In any event they should be thoroughly examined by reliable divers after the work has been completed. If many leaks are found their elimination is likely to be very costly and tedious, so that it is expedient to omit no precautions to prevent their occurrence.

PIPE LAYING IN COFFERDAMS

In shallow, sheltered, still water where there is good bottom, preferably clay, it may sometimes be expedient to build a cofferdam of sand bags, embankment, puddle, sheet piles, or a combination of them, unwater it, and install the pipe in the manner usual in open trench. When this is done it will usually be best to build the cofferdam in successive sections of moderate lengths ,completing one before another is unwatered and thus economizing on cofferdam materials, maintenance and pumping.

For very long lengths of submerged pipe not installed by the cofferdam method, it may be advisable to lower the pipe in several long sections independently, enclose the adjacent ends of these sections by cofferdams, pump out the water and make the special connections in the dry. Otherwise adjacent sections may be connected by divers with special adjustable sleeve lengths.

After the pipe has been installed and tested it may require to be artificially backfilled, but in many cases the trench will be rapidly filled by the action of the water itself and thus automatically provide sufficient covering to protect the pipe.

Rapid Road Concreting

An unusually high rate of progress in concreting a 14-foot highway from 5 to 7 inches thick, west of Georgetown, Del., has been made by Elder & Company, executing contract CS-2 of the Delaware State Highway Department.

The work is of the standard type adopted by the Highway Department. The aggregate and cement, which are delivered in large wooden batch boxes, are unloaded and emptied into the charging hopper of an 8-bag Koehring mixer by a locomotive crane mounted on caterpillar traction which handles them with great rapidity so that little or no time is lost between batches. It is required that each batch shall be mixed at least 1½ minutes and as many as 30 batches have been mixed and placed in one hour.

Each batch lays a strip of pavement 5½ feet long and of the full width of the roadway. Although there has been great difficulty in maintaining a constant adequate supply of aggregate and cement and the machine has never been able to work long at full capacity on account of lack of material, it has attained an output of 781 linear feet in one 9-hour day. After three batches of concrete have been mixed and laid, the mixer is moved backwards 15 feet by the locomotive crane, which is kept attached to the machine and hauls the latter like a trailer.

The mixing machine is operated by a force of two men, one man operates the locomotive crane, and sixteen more men are required for setting, finishing and covering the concrete, trimming the sub-grades and setting the forms, making an average total of twenty men on the road, besides which there are about nineteen men in storage yards receiving and handling cement and aggregate.

8-BAG MIXING MACHINE LAYING 70 SQUARE FEET OF PAVEMENT EACH BATCH

NEWS OF THE SOCIETIES

Jan. 17-18 — OHIO STATE ASSOCIATION OF BUILDERS' EXCHANGES [illegible] Hotel, Youngstown, O.

Jan. 18 — WATER POWER LEAGUE OF AMERICA. First annual meeting, Engineering Societies' Building, New York City.

Jan. 18-20 — IOWA ENGINEERING SOCIETY. Annual meeting. Des Moines, Ia.

Jan. 19 — INTERNATIONAL CUT STONE CONTRACTORS' AND QUARRYMEN'S ASSOCIATION, Inc. Annual meeting. Congress Hotel, Chicago, Ill.

Jan. 19 — AMERICAN SOCIETY CIVIL ENGINEERS. New York City.

Jan. 19-20 — MISSISSIPPI VALLEY ASSOCIATION and the NATIONAL DRAINAGE CONGRESS. Joint conference, Harrington Hotel, Washington, D. C.

Jan. 21 — ENGINEERS' CLUB OF PHILADELPHIA. Bellevue-Stratford Hotel.

Jan. 25 — NEW JERSEY STATE ASSOCIATION OF COUNTY ENGINEERS. Annual meeting. Engineers' Club, Trenton, N. J.

Jan. 25 — ATLANTA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with Atlanta Section, A.S.C.E. Carnegie Library.

Jan. 25 — PHILADELPHIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Engineers' Club of Philadelphia.

Jan. 25-27 — MICHIGAN ENGINEERING SOCIETY, STATE ASSEMBLY OF THE A.A.E. Detroit, Mich.

Jan. 25-27 — THE AMERICAN WOOD PRESERVERS ASSOCIATION. Place of meeting to be announced later.

Jan. 25, 26, 27—ASSOCIATED GENERAL CONTRACTORS. Annual meeting, New Orleans. Secretary's Office, Washington, D. C.

Jan. 27-28 — INDIANA ENGINEERING SOCIETY. Annual meeting, Indianapolis. Secretary, Charles Brossman, Merchants Bank Building.

Jan. 28 — COLORADO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Metropole Hotel.

Jan. 31-Feb. 5—NATIONAL BRICK MANUFACTURERS' ASSOCIATION AND COMMON BRICK MANUFACTURERS' ASSOCIATION OF AMERICA. Joint meeting. Hotel Pennsylvania, New York City.

Feb. 1-2—NEW YORK STATE ASSOCIATION OF BUILDERS. Convention, Rochester, N. Y.

Feb. 1, 2, 3—ONTARIO PROFESSIONAL MEETING in conjunction with the annual meeting of the Engineering Institute of Canada. Toronto.

Feb. 7-8 — FLORIDA ENGINEERING SOCIETY. Annual meeting. Lakewood, Fla.

Feb. 9-12 — AMERICAN ROAD BUILDERS' ASSOCIATION. Eighteenth annual convention, eleventh American Good Roads Congress and seventh National Good Roads Show, Coliseum, Chicago, Ill.

Feb. 11-12 — ENGINEERING SOCIETY OF WISCONSIN. Annual meeting. Madison. Secretary, Leonard S. Smith, Madison, Wis.

Feb. 14-16 — AMERICAN CONCRETE INSTITUTE. Annual meeting. Annual dinner, Hotel Chicago, Ill. Secretary, Harvey Whipple, New York. Headquarters, Detroit, Mich.

Feb. 16-18 — AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Seventh midwinter convention. Engineering Societies' Building, New York City.

May 17-19 — NATIONAL FIREMEN'S ASSOCIATION. Twenty-third annual convention, Fort Wayne, Ind.

June 7-9 — NATIONAL FIRE PROTECTION ASSOCIATION. Annual meeting, San Francisco, Cal.

June—CONFERENCE OF MAYORS AND OTHER CITY OFFICIALS, State of N. Y. 12th Annual Conference. Elmira, N. Y.

June 6-10, 1921 — AMERICAN WATER WORKS ASSOCIATION. Annual convention at Cleveland, Ohio. Secretary, J. M. Diven, 153 West 71st St., New York.

INDIANA ENGINEERING SOCIETY

Thursday, January 27, at the Claypool Hotel, Indianapolis, the Indiana Engineering Society will hold its forty-first annual meeting, including joint sessions with other local chapters of engineering societies.

At the first session, papers will be presented on "Specifications for Road Materials," by Fred Kellam, Indianapolis, and on "Freight Rates and Construction Work," by R. C. Yoeman, Indianapolis.

At 2 p. m., there will be a joint meeting of the Indiana Engineering Society, in which county surveyors and American Association of Engineers will participate. The program will include discussion on "Engineers' License Law" and "County Surveyors' Bill." "The Economy of Early Contracts," by C. D. Franks, Indianapolis, and "Bonds As Applied to County Work."

At 7:45 p. m., there will be a joint meeting of the Indiana Engineering Society, American Society of Mechanical Engineers, American Society of Electrical Engineers, Indianapolis Scientific Club.

Papers will be presented on "Operating Characteristic of Small Steam Driven Pumps," by L. V. Ludy, LaFayette; "Some Problems in Supplying Electric Power Service to Rural Communities," by D. D. Ewing, LaFayette; "Lightning Protection for Rural Transmission Lines," by D. L. Curtner, LaFayette, and "The New 600,000 Volt Testing Laboratory at Purdue University," by C. Francis Harding, LaFayette.

On January 28, papers will be presented on "Preservation Treatment for Wood Poles," by R. V. Achatz, LaFayette; "Problems in Concrete Construction," by W. K. Hatt, LaFayette; "Residence Water Supplies," by G. C. Blalock, LaFayette, and on "The Brick Paved Highway," by Will P. Blair, Cleveland, Ohio, followed by routine business.

At 6:30 p. m., the annual dinner of the Indiana Engineering Societies will be held jointly with all other engineering organizations. Dean A. A. Potter, of Purdue University, and others will speak.

NEW ENGLAND WATER WORKS ASSOCIATION

The December meeting of the New England Water Works Association was held on December 8 at the Copley Square Hotel, Boston, Mass. The feature of the meeting was the reading of a paper on "The Water Supply of Geneva, Switzerland," which was illustrated with lantern slides. The paper was written by Monsieur A. Betant, engineer and director of water supply service for the city of Geneva, and translated from the French by Professor Whipple, who read the paper to the meeting and contributed an introductory description of the city of Geneva and its environs. The paper described the pumping system and water supply layout of the city, and was followed by pictures of the Geneva plant shown on the screen.

The subject of "Cleaning and Painting Standpipes" was opened by Charles W. Sherman. Among those taking part in the discussion which ensued were Reeves W. Newsom, Samuel E. Killam and Morrison Merrill, and a letter from Professor Harold K. Barrows, relative to this subject, was read by Secretary Frank J. Gifford. There was also some discussion of the best method of extinguishing fires in coal piles and the proper way of applying water in such cases, by S. H. Taylor, Chief Jesse Barrett, William F. Sullivan and John C. Chase; also a brief discussion of the subject of fires originating between the jackets of cotton fire hose during tests of pumping engines by Charles C. Sherman of Boston.

NEW JERSEY COUNTY ENGINEERS

The annual meeting of the New Jersey State Association of County Engineers will be held in Trenton on January 25 at the Engineers' Club, located over the Grand Theater on South Broad street, near the court house.

Papers will be presented on "Bridges for New Jersey Roads," by Charles A. Meade, bridge engineer, New Jersey Highway Department; "Some Facts Relating to Motor Vehicle Registration," by Wm. L. Dill, Commissioner of Motor Vehicles; and "Testing and Laboratory Control of Large Highway Contracts," by R. B. Gage, chemical engineer.

ENGINEERS' CLUB OF DES MOINES

The Engineers' Club and the Chamber of Commerce of Des Moines are making special provisions for the entertainment of the wives of visiting engineers at the Iowa Engineering Society's annual meeting. Engineers have been urged to bring their wives to this meeting.

Among other things the ladies' section of the program includes an afternoon tea at the Hoyt Sherman Place, a theater party, banquet and dance.

The society meets this year at the Chamberlain Hotel in Des Moines, January 18, 19 and 20.

ENGINEERS' CLUB OF SAN FRANCISCO

The Engineers' Club of San Francisco, at its regular noon-day meeting on December 1, was addressed by J. Waldo Smith, chief engineer, board of water supply, New York City, on New York's water supply problems.

WESTERN SOCIETY OF ENGINEERS

At the meeting of the Western Society of Engineers held on December 7 there were three addresses on "The Commercial Use of the Airplane." John F. Hayford discussed research problems; A. R. Rhenisch, recent progress and costs; and Walter Painter, commercial airplane types.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

ASPHALT BLOCK PRESS

An expensive feature of the asphalt paving industry is the inability to work at full time all the year around. Weather conditions as well as the inherent conditions associated with contract work interfere with the operation of the plant and at times necessitate a complete suspension of work. It has been estimated that no more than 150 to 200 full days' work is done in a year. During these periods of enforced idleness the plant overhead goes on just the same and the operators' profits are greatly reduced. If provided with an asphalt-block press, the plant could run at full blast the year around and this increased utility would represent practically clear profit.

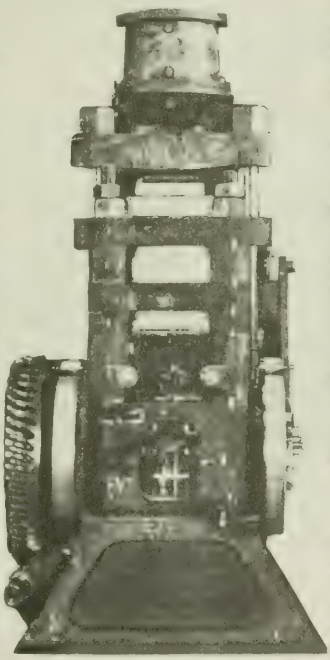
A press for manufacturing asphalt blocks is being put on the market by the National Moulding Press Corporation of 262 Fulton street, Brooklyn, N. Y., which, by virtue of its compactness, can be installed in a paving plant without altering any of the existing features. The press is constructed as a single unit which can be operated either by direct connection with an electric motor or by a belt connection with any existing jack shaft already installed in the plant. The press itself occupies a space of about 4 by 7 feet out-to-out and stands approximately 8 feet above the floor.

The aggregate and asphalt can be mixed by the same appliances used for asphalt paving mixture, except that there should be more careful screening and grading of the aggregate. The mixture is fed to the hopper of the block machine by a man or men on the upper floor of the plant, the correct rate of feeding being insured by an automatic indicator which guides the men in their feeding.

From the hopper the mixture drops by gravity into the mould, which is brought under the hopper to receive the charge, is filled and is then brought to a position between two vertical plungers, the motion of which is so synchronized that, when the mould is in position the lower one moves upward and the upper one downward, into the mould, compressing the block under a pressure that can be regulated as desired up to 400 tons. The plungers then separate, clearing the mould, the mould returns for a new charge, the lower plunger lifts the block to the level of a belt conveyor, the mould (which has meantime been refilled) moves forward and pushes the block onto the belt, at the same time going to position between the moving plungers to permit another block to be compressed.

The blocks are carried by the belt conveyor to and through a trough filled with water, which is flowing in a direction contrary to the motion of the blocks so as to be coldest where the blocks leave the trough. The blocks are then substantially cooled and solid to be carried away on wheelbarrows, by conveyor or other means, and stacked for shipment.

The pressure is transmitted by means of a system of toggle joints and an accumulator incorporated in the press. The press requires 25 to 30 horsepower for operating it. The capacity is approximately 1,000 standard asphalt blocks or tile per hour. The same machine can be used for making blocks of any of the three regular commercial thicknesses.



ASPHALT BLOCK PRESS

Advantages claimed for this machine are its compactness, economy of maintenance, absolute control of pressure exerted on the blocks, the feeding of the mixture to the mould, and the regulation of the uniformity of the blocks by means of an unique system of automatic safety devices incorporated in the press. The materials used in the construction are the best obtainable, the shaft for instance being made of special nickel steel and heavy bronze bearings being used throughout, while the frame of the structure is of cast steel.

EASTON INDUSTRIAL RAILWAYS

Bulletin 510 of the Easton Car and Construction Company is intended to promote the use of industrial railways and railway equipment for the handling of aggregate materials used in road building. Easton steel batch box buckets, generally furnished with separate compartments for the proper proportions of sand, stone and cement and having a watertight cover for the cement, can be supplied of wood or steel. Batch boxes having bottom dumping doors or trunnions for tilting are supplied also. These can be loaded at the plant by any convenient system of derricks, overhead bins or tunnels under stock piles, loaded on flat cars on industrial track in 16-foot sections mounted on corrugated steel ties with clips and bolt fastenings, curved sections and standard turnouts. Descriptive bulletins, plans and estimates and other information will be furnished on application to the Easton Car and Construction Company.

Bulletin 510 gives typical diagrams showing the arrangement of tracks and operation of cars for several ordinary conditions where the industrial track is laid on the shoulder of the road, or on subgrade; where the concreting is commenced at the loading plant at one end of the road, or where the concreting is begun with a long haul from the loading plant.

One plan shows the arrangement of a surface stock pile and tunnel for aggregate and a gravity bin for bulk cement, the materials being unloaded by a locomotive crane operating on a track between the stock piles and the railroad, thus providing a large storage capacity at small expense.

CLEVELAND AIR TOOLS

Bulletin 11 of the Cleveland Pneumatic Tool Company describes and illustrates the new Cleveland pistol-grip chipping hammer which does not require the air vent port that in other hammers allows a continuous wastage of air. The throttle valve graduates the air supply and rescues itself when worn. The hammers have high speed steady operation and dustproof features.

There are twelve styles and sizes of chipping, caulking and beading hammers weighing from 4 ½ to 20 pounds each and striking 950 to 3,000 blows per minute.

Bulletin 47 describes various sizes and patterns of angle valves and manifolds for compressed air service. The Cleco valves are simple in construction, having only three parts—the body, plug, and handle. They require no packing and have no valve gate to renew or stems to bend or break. They are absolutely airtight under all pressures, and have an unrestricted air passage.

INDUSTRIAL NOTES

The Oxweld Acetylene Co. has appointed the Standard Supply & Equipment Co. of New York and Philadelphia as eastern sales agent for Eveready welding and cutting apparatus and supplies, with George E. Temple as manager of its welding and cutting department.

The National Lime Association has appointed Laurence H. Hunt manager of the construction department and Major E. Holmes manager of the chemical department.

J. C. Kopf, formerly manager of the engineering department of the Duff Manufacturing Co., has been appointed research engineer and placed in charge of a newly established research department. F. W. Schwerin is now manager of engineering.

NEW ENGINEERING BUSINESS EXCHANGE OFFICE

The Engineering Business Exchange announces the opening of a Pacific Coast branch with James T. Whittlesey as director and with offices in the Claus Spreckels building, San Francisco.

ATLAS HAND BOOK

The Atlas Portland Cement Company has issued an attractive 4 x 7-inch, 144-page bound volume entitled: "Atlas Hand Book on Concrete Construction," at a price of $2, which is offered as a holiday gift, on request, to readers of the ever attractive and useful Contractors' Atlas. The purpose of the book is to provide in convenient form for the average builder practical information on plain and reinforced concrete.

It is written in a brief, clear and non-technical style to give valuable hints and suggestions, describe ordinary methods and standards and afford convenient aid in general concrete matters to the ordinary contractor.

It gives reliable data concerning the proper selection and proportioning of concrete materials, tests, and general instructions for concreting under water, in cold weather, and for finishing, mixing, placing concrete and making it watertight.

It contains chapters on reinforced concrete columns, beams, girders, towers, sidewalks and various common structures like garages, elevators, tanks, pavements, foundations, culverts, bridges, retaining walls and the like, with sketches and dimensioned details of forms and convenient appliances, together with various tables of sizes, strength, quantities, materials required for construction and other useful information and instructions for estimating quantities and costs, with sample estimate sheets for concrete construction work.

EASTERN PAVING BRICK MANUFACTURERS

The annual meeting of the Eastern Paving Brick Manufacturers' Association was held at the Waldorf-Astoria Hotel on December 14 and 15, 1920. Over twenty executives were in attendance. R. L. Wilson, of New York, president; R. T. Hutchins, of Wheeling, W. Va., treasurer; W. C. Perkins, of Philadelphia, secretary.

THE CEMENT GUN COMPANY, INC.

The Cement Gun Company announce the removal of its main office from Allentown to Cornwell, Pa., a suburb of Philadelphia.

TRAYLOR TRUCKS

Trucks and tractors manufactured by the Traylor Engineering & Manufacturing Company will be distributed by B. C. Collier from his office at Cornwell, Pa.

CHAS. T TOPPING MACHINERY COMPANY

Chas. T. Topping, formerly of the Chas. T. Topping Machinery Co., Pittsburgh, dealers in contractors' equipment, who has been associated with the Lakewood Engineering Co., has engaged in the construction business for himself and has established his organization in the House building, Pittsburgh, and will act as district sales representative for the Austin Machinery Corporation, Chicago, manufacturers of concrete mixing, excavating, road building and material handling machinery and equipment.

The Willite Road Construction Co. is starting construction on three miles for the State Highway Department of Georgia on the Dixie Highway between Fitzgerald and Ocilla, Ga., Project S-11-7, A-3, unit 1,250 square yards. Cummer plant is now being erected at Ocilla. Mr. T. J. Carson is superintendent in charge for the Willite Company.

P. Flanigan & Sons, Baltimore, Md., have started work on two miles of the Bel Air Turnpike. A Willite surface will be used. This is the first Willite to be constructed by the Maryland State Road Commission.

About two miles of a seven-mile project for Muskegon county, Mich., have been completed by the Willite Road Construction Co. of Michigan. The work consists of a 3-inch Willite base and 2-inch Willite top.

Sales of Mack trucks in November increased 43 per cent over the month of October, announces the International Motor Company. The three months period just ended represents an 18 per cent increase over the same period in 1919.

PERSONALS

Sloan, Charles E., has been appointed city engineer of Manteca, Cal.

Schreiber, Fred H., formerly assistant state highway engineer of South Dakota, has been appointed state highway engineer to succeed F. S. Peck, who resigned.

Stromquist, W. G., formerly of the United States Public Health Service, is now sanitary engineer with the health department, Memphis, Tenn.

Tyrrell, George G., formerly with the Missouri State Highway Department, has been appointed resident engineer on the construction of Federal aid roads for the Mississippi State Highway Department.

Jacob, Thomas N., has been appointed chief engineer of the East Side Levee and Sanitary District, East St. Louis, Ill., with Elmer R. Rodenberg as resident engineer, and J. E. Weinel as field engineer.

Woodyard, Burdette, has resigned the position of highway engineer of Wood county, W. Va.

Batson, S. R., has resigned his position as highway engineer for Jefferson county, Ala.

Forman, Morris, has accepted a position as assistant drainage engineer, Winnebago county, Iowa.

Pomper, Alexander A., has been appointed assistant highway engineer, Monroe county, Mo.

Caton, John H., 3d, has been appointed division engineer in the Bureau of Public Works, La Vega, Dominican Republic, and is engaged in the construction of the new road across the republic.

Bracher, Gus A., has been appointed engineer of Washington county, Tex.

Harding, H. McL., consulting engineer of New York, has been retained by the city of New Haven, Conn., as consulting engineer on its port development.

Seymour, Horace Llewellyn, recently resigned as engineering assistant to Thomas Adams, the Dominion government's town planning adviser, in order to become affiliated with Frank Barber, consulting engineer, Toronto.

Brazier, H. A., city engineer of London, Ont., sailed for England on November 23 to investigate the activated sludge process for the treatment of sewage.

Danks, F. A., formerly assistant engineer of British Forgings, Ltd., Toronto, and later assistant editor of the *Canadian Engineer*, has been appointed secretary-treasurer of Automatic Telephone & Time Recorders, Ltd., of Toronto.

Lewis, Nelson P., chief engineer of the board of estimate and apportionments, New York City, retires this month from the municipal service, with which he has been connected for thirty-four years.

Allen, John R., heating and ventilating specialist, died at Pittsburgh on October 20. Mr. Allen has been connected with the college of engineering, University of Michigan, and later with the college of engineering and architecture, University of Minnesota; and at the time of his death was acting as consulting engineer on ventilation to the chief engineer of the New York and New Jersey commissions in charge of the construction of the Hudson river vehicular tunnels.

Waitt, Arthur M., consulting engineer and railroad specialist, died November 10, at Sharon, Conn. Mr. Waitt had been engaged in railroad work for 40 years, and at the time of his death was engaged in private practice as consulting engineer and railway specialist.

Wolfel, Paul L., chief engineer of the McClintic-Marshall Co., of Pittsburgh, one of the foremost bridge engineers of the day, died on December 28 at Philadelphia.

Wolfe, John W., division engineer, Board of Local Improvements, Chicago, died on December 12.

PUBLIC WORKS.
CITY COUNTY STATE
A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879.
Vol. 50 FLORAL PARK, JANUARY 22, 1921 No. 4

Electrically Driven Centrifugal Pumps at St. Paul

After operating the plant for more than two years, the Water Commissioners compare the cost of this with the steam-operated unit in service previous to that time, showing that for their conditions the latter cost 20 per cent more than the electrically driven pumps.

In 1917, the water commissioners of St. Paul, Minn., installed in the McCarron pumping station two electrically driven centrifugal pumps. A quite detailed account of the pumps and their operation is given in a report published by the commissioners in 1920. From that report is taken the matter contained in the following article.

This type of pump was selected because the cost of operating them, taking into consideration interest and depreciation upon the investment and the cost of electrical power, was less than the similar costs of any steam-driven pumping unit on the market at the time. The capacity guaranteed was that each unit would deliver not less than 5,000 gallons of water per minute against a total dynamic head of 171 feet and not more than 5,500 gallons against a total dynamic head of 158 feet.

The pumps were manufactured by the DeLaval Steam Turbine Co., of Trenton, N. J. They are single stage, double suction, single impeller type, designed to run at 1,200 revolutions per minute. They are operated by motors manufactured by the Electric Machinery Co., of Minneapolis, which are of the rotating field, synchronous type and each has a full load rating of 300 horse power when impressed with 3 phase, 60 cycle, alternating current at approximately 2,200 volts. Each motor has a 2.25 kw., 125 volt direct connected exciter for furnishing exciting current when running. They are designed to bé started and brought to approximately synchronous speed as simple induction motors. When approximately synchronous speed has been reached, the auto transformers are cut out and full line voltage is impressed on the stator, the exciter is connected to the rotor windings and the motor falls into synchronism.

Each unit had a guaranteed minimum efficiency, wire to water, of 72 per cent when pumping continuously against any head between 158 and 171 feet and within the limits of the capacity of the pump. Shop tests indicated that both the pumps gave an efficiency of 80.5 per cent when delivering 5,500 gallons against a 150-foot head, and the motor gave an efficiency of 95.5 per cent on shop test at full load. When first constructed the exciter was only 1.75 kw. capacity, but in a performance test this was found too small and the 2.25 kw. exciter was substituted. After being placed in operation the efficiency of the two units steadily increased for three or four months and the average operating efficiency for the year 1918 was 79.5 per cent, which was higher than the efficiency obtained during the acceptance test.

Up to January 30, 1920, no repairs or replacements had been made to either pump. The rotor windings on one of the motors twice became loose and slightly damaged the stator windings so that they had to be rewound over a small area, but the damage was slight and the cost small. Toward the end of 1919 there was a slight falling off in efficiency and the top casing on one of the pumps was removed and the impeller examined, when the edges of the vanes were found to be a little frayed and the labyrinth rings somewhat worn. While the wear was very slight considering the length of time in operation, it was perhaps sufficient to affect the efficiency and it was proposed at the time of the report to substitute a new impeller for the old one.

The conclusion that this type of pump would be more economical than the steam pump has been borne out by the results. A steam plant with its boilers, condensers, feed-water heaters, boiler-feed pumps, super-heaters and other accessories is comparatively complicated and requires men of higher mechanical skill and intelligence than does the electric pump. The size of con-

taining buildings must be considered also and these can easily be compared on the cubic foot basis.

The charge for electrical energy is to a great extent governed by the ability of the city to shut down the pump during peak electrical loads at the plant of the company supplying the current, this being possible only when there are reservoirs for furnishing the water supply during such shutdowns; also upon whether or not the power company needs a balancing load and is therefore willing to grant special rates. The cost of electrical energy, coal and gas, as well as skilled labor vary so much in different localities that no attempt will be made to show what might be expected in other localities, but only what has been found in St. Paul.

The last year that a steam unit was used continously in the St. Paul plant was 1916, this unit being a 10-million-gallon Allis-Chalmers vertical, triple-expansion, crank and fly wheel type. During the year in question the average lift was 141.6 feet; the total amount of coal used, including that for changing boilers, but not that for heating the building, was 3,299,964 pounds, the amount of ash was 7.9 per cent; the duty per 100 pounds of coal was 106,303,700, Youghiogheny lump coal being bought on the B. t. u. basis at an average price of $4.40 per ton. This gave the fuel cost of raising one million gallons of water one foot as 1.73 cents.

The daily average pumping was a little over 8 million gallons and the pump therefore was not working at its full capacity and therefore probably not at its highest efficiency. However, in most plants the requirements do not equal the full capacity of the pump and, because of the difficulty of starting a large triple-expansion pumping engine, it is better to run them more slowly than to shut down and bank the fires. In other words, the difficulty of starting a triple-expansion pumping engine, and the consequent loss of efficiency in running it below its rated speed in order to co-ordinate the rate of running with the demand, is a point against this type of pump when compared with the ease of starting the centrifugal type of pump. It is possible that, if mechanical stokers had been used in this plant, a cheaper grade of fuel could have been burned, although in Minnesota freight charges represent a large part of the coal cost. The boiler performance records show an average actual evaporation of 7.76 pounds of water per pound of coal from a boiler feed water temperature of 120 degrees.

The power company contracted to furnish electrical energy to pump one million gallons of water against 158.5 feet dynamic head with an over-all efficiency of the combined pumping unit of 72 per cent at the rate of $4, the price to vary with the dynamic head and the efficiency, in direct proportion to the actual head and efficiency as determined in operation of the plant. As a matter of fact the average over-all efficiency of the electric pumping unit in 1918 was 79.5 per cent and the average head was 152.3 feet, and the cost was $3.48 per million gallons, or 2.28 cents per million gallons raised one foot. In 1919 the average over-all of efficiency was 78.5 per cent and the cost per million gallons raised one foot was 2.349 cents. Each of these costs is materially higher than the fuel cost of pumping with steam.

Averaged for a term of years, the cost of miscellaneous repairs, supplies, waste, oils, etc., for each million gallons raised one foot was 0.55 cent for the steam operated pump and 0.35 cent for the electrically driven pump. As to depreciation, the water commissioners believe that depreciation should not be charged in either case, since either type will give excellent service for 50 years; accessories, including boilers and impellers will have to be replaced every few years, but these and repairs should be charged to operation.

Labor is an important item. The steam plant requires men of higher intelligence and greater mechanical ability than the electric plant and also requires more men. It was estimated that at the present time the labor costs to raise one million gallons of water one foot would be 2.16 cents for the steam plant and 1.11 cents for the electric plant. "However, it is questionable if this holds good in practice for the reason that most cities hesitate to depend absolutely upon electricity for large installations. It is generally found that the men operating the electrical units are fully capable of operating the steam units and further that jobs are found for men who can qualify as firemen in order to have them available in case of necessity. When this is considered, the labor costs for the electrical unit approach those for the steam-operated unit."

Summing up the costs, the commissioners find that for the steam-operated pump the energy charge was 1.73 cents; miscellaneous supplies, repairs, etc., 0.55 cent, and labor 2.16 cents, or a total of 4.44 cents. For the electrically operated pump the energy charge was 2.28 cents; miscellaneous supplies, repairs, etc., 0.32 cent, and labor 1.11 cents, or a total of 3.69 cents. These figures show the steam operation to cost about 20 per cent more than electric.

Although depreciation was not included, there is to be considered the fact that the electrically driven unit costs less than a steam plant. Another question to be considered is whether or not conditions warrant placing absolute dependence upon electrical current, a question which must be decided for each individual case. "Very often when additional pumping capacity must be provided, the low first cost of the motor-driven centrifugal pump simplifies matters and solves what otherwise might be a difficult problem."

Financing Sacramento's Filtration Plant

The city of Sacramento, in financing its filtration plant which is expected to cost about $1,200,000, made arrangements with a San Francisco bank to take the bonds totaling $1,200,000, but to purchase them from time to time as the money is needed, thus saving the interest payments on a considerable amount of money lying

idle for months until the progressive steps of the construction should call for it. The plan contemplated the immediate purchase of $314,000 worth, holding this money for the payment of the construction work, and agreeing to take additional bonds at intervals as the sums in hand may be exhausted.

For State-Owned Cement Plants

Judge J. M. Lowe, president of the National Old Trails Association, urges the building of state-owned cement plants as one of the first steps to be taken by the Missouri legislature in the expenditure of the 60 million dollars of road bonds which have been voted. Cement must be used in the building of all high-class roads; and cement rock, which is the principal material used in the manufacture of cement, is available near the state penitentiary, and convict labor could be used in the state cement plants, the construction of which should be begun at once by the state, so as not to delay at all the building of roads. The cement alone, if purchased from private plants, would cost more than $11,000 a mile, a total cost of more than $17,600,000.

Avenue U Sewers, Brooklyn

1,500 linear feet of 102-inch concrete storm water sewer built in open trench in wet ground and a 30-inch low-level pipe sewer constructed in advance. Heavy work progresses steadily with small force and limited amount of plant operating at a single point.

Extensions of the sewerage system in the southern part of the borough of Brooklyn, New York, include a section of 102-inch concrete sewer 1,500 feet long on the center line of Avenue U which makes connection with the 114-inch sewer on West 11th street and has a right-angle curved bend to connect with a future 102-inch extension on West 5th street and a 30-inch pipe sewer on West 11th street.

The storm sewer has a reinforced concrete flat slab roof 10 inches thick, a reinforced V-shape invert faced with selected bricks, and 17-inch vertical side walls without reinforcement. It is supported on a platform of planks laid on the tops of transverse bents of wooden piles. The external outline is rectangular with a width of 14 feet 7 inches and a height of 8 feet 8 inches with interior dimensions of 11 feet 9 inches in width and 6 feet in center height, with rounded corners. The upper surface of the center of the invert is from 3 feet to 1.58 feet below datum or mean high tide elevation, which is approximately ground water level.

Parallel to the storm water sewer, and at an invert elevation of from about 12 feet to 8.88 feet below datum, with its center line 3 feet 11 inches from the outer face of the storm water sewer, there is a 30-inch pipe house sewer enclosed in a rectangular mass of concrete with a minimum thickness of 6 inches, supported on foundation piles averaging two for every 4 linear feet of the sewer. The house sewer receives the flow from house connections through 8-inch stand pipes also enclosed in concrete and having tees receiving connections from both sides of the street, the 8-inch pipes that cross the street being supported directly on the roof of the storm water sewer.

The principal materials involved in construction are 1,478 linear feet of 30-inch vitrified sewer pipe, 348 linear feet of 6-inch house connection, 1,339 linear feet of 8-inch house connection, 488 feet of standpipes, 105,000 feet B. M. of foundation planking and pile caps, 20,000 linear feet of

CONCRETE INVERT READY FOR PAVING

WATER COLLECTED IN TRENCH WHILE PUMPS STOPPED FOR SHIFTING AHEAD, FINISHED INVERT AND ROOF FORMS IN BACKGROUND

wooden piles, 65,000 feet B. M. of sheeting, about 3,000 yards of concrete, 100,000 pounds of reinforcement steel and about 29,000 yards of excavation and 20,500 yards of backfill.

The work is designed and supervised by the Bureau of Sewers, Borough of Brooklyn, Arthur J. Griffin, chief engineer, and is being executed by Charles McDonald for a contract price of about $195,601.25.

EXCAVATION

A trench about 22 feet wide and from 13 to 23 feet deep is excavated in the center of the macadam street, where the old roadway surface is removed by hand and the sandy soil below is excavated by a ½-yard Blaw-Knox clam-shell bucket operated from the 40-foot boom of a stiff-leg derrick equipped with a two-drum Lidgerwood hoisting engine and traveling on a 25-foot gauge surface track concentric with the sewer. The derrick bucket delivers the excess soil to carts by which it is hauled about a ½ mile to the spoil banks. The remainder of the excavated material is delivered directly to a steel 3-yard sidedump car on a 30-inch industrial track laid alongside the trench to a point beyond the end of the finished sewer, on which spoil is dumped for backfill without rehandling. The distance between the excavating face and the face of the backfill is maintained at about 200 feet, which is limited by transverse bulkheads at both ends, shifted as the work advances.

PILE DRIVING

The trench is sheeted with two tiers of wooden sheet piles, the upper one having 2-inch units 8 or 10 inches wide and 16 feet long, and the lower tier having units 14 feet long. Two pile units 10 inches wide, or three units 8 inches wide, are driven at once by the 1,500-pound drop hammer operated by the derrick engine in leads suspended from the derrick boom. The piles are driven to a penetration about 4 feet below the bottom of the trench, the driving being assisted by a jet of water under city pressure. They are driven full depth at the rate of about 8 linear trench feet per day, and, after the completion of the sewer construction, are pulled by the derrick boom at the rate of about 16 linear trench feet per day, and redriven three or four times. The piles are braced by seven tiers of 8 x 8-inch transverse struts 10 feet apart on centers, engaging corresponding lines of 8 x 8-inch rangers.

After the excavation of the trench to sub-grade of the storm-water sewer, a third line of sheet piles is driven about 40 inches clear of the lower tier of sheeting and is braced to it and the sand between it and the outer sheeting is excavated down to subgrade for the sanitary sewer and the rangers and braces set as required.

Foundation piles 6 to 8 feet long are then driven in pairs 3 feet apart, capped and planked to support the house sewer pipe, which is laid on them bedded in a solid mass of concrete. The construction of this house sewer is always completed in advance of the storm-water sewer invert. It is the key to the difficult situation caused by the large amount of ground water and provides drainage for the excessive saturation of the sand up to a distance of about 8 feet below the surface of the ground.

PUMPING

At intervals of about 50 feet, 6 x 8-foot sumps are sheeted down 4 feet below sub-grade of the house sewer and are drained by one electrically operated 6-inch and one 8-inch Lawrence centrifugal pumps.

Over one of these sumps there is a timber gantry frame supported on the upper tier of the trench cross-braces. From it the pumps are suspended by tackles with which they are hoisted and sustained while the gantry is skidded ahead to another position as required.

For another sump there is provided a light gantry supported on beams spanning the trench. From this gantry tackles operated by a hand windlass or crab and differential chain hoists are suspended to handle the pumps. When another pump is required at either end of the open trench it is handled by the boom of the traveling derrick. Both of the pumps can be run continuously day and night without attendance, thus handling a large quantity of water in a very simple and satisfactory manner. If the water gets low, the 6-inch pump will suck and suck but will not require priming; the other pump requires priming if the water gets low but will start again automatically when the water rises 1 foot.

FOUNDATION PILES

The piles in the house sewer trench and those in the storm-water sewer trench are rapidly driven by the aid of a ½-inch jet of water under 50 or 60 pounds city pressure delivered through a 3-inch steam hose to the jet pipe, which quickly bores a hole in the sand and maintains it until the pile settles in it to approximate position and is hammered down to the exact elevation by an 8 x 8-inch wooden ram 10 feet long operated by hand. The piles in the transverse bents are capped with 8 x 8-inch timbers bored to receive the drift bolts. The piles are jetted down to approximate position in about three minutes when the ground is good.

CONCRETING

The construction of the storm-water sewer requires about 2 cubic yards of concrete per linear foot of sewer, which is mixed in a two-bag Ransome portable mixer moving along on the surface of the ground adjacent to the trench as the work progresses and delivering the concrete to a wooden chute through which it is spouted directly to position.

The invert is concreted between vertical wooden side forms in sections 32 feet long which are laid in about 3½ hours. Transverse wooden templates or ribs are set at the required elevation and securely nailed to the cross-braces of the trench timbering. To them are nailed three full-length panels of wooden lagging, two wide outside panels and one center panel with 8-inch openings between them, through which the concrete is placed for the center of invert, the remainder of the con-

crete being delivered through the openings at the bottoms of the side walls.

After the invert has been stripped and faced with brick or tile lining, a 32-foot section of upper forms is advanced on it and the walls and roof concreted in about 4½ hours. The upper forms have wooden lagging nailed to wooden frames carried on collapsible steel Blaw-Knox towers.

As the concreting is finished it is followed by a traveling rear derrick that corresponds to the excavating derrick in front and is operated by a two-drum Mundy hoisting engine. This derrick delivers stone and sand to the concrete mixer, pulls the sheet piles, removes the braces and handles backfill if necessary. The two derricks advance with an average space of about 300 feet between them.

During last summer the sewer was constructed at an average rate of about 5 feet per day by an average force of twenty men. Construction was commenced in September, 1919, and was about one-third completed December 1. It is expected that the work will be discontinued during severe winter weather and will be completed early next season.

Modern Cast Iron Pipe*

By A. F. Macallum, C. E. †

Advantages of De Lavaud centrifugal cast iron pipe demonstrated by tests made by Professor Gillespie, of Toronto University.

The present specifications for cast iron pipe are based on iron having a tensile strength of 20,000 pounds. When higher standards are given under the present foundry methods and mixtures the pipe is apt to be more brittle. On account, however, of new methods being adopted in the method of manufacturing iron pipe consideration is now being given to the revision of the specifications to meet these new conditions. This new method, developed by De Lavaud, a French engineer, is now being used in this country after being subjected to tests in comparison with the ordinary standard cast iron pipe by Professor Peter Gillespie of the Department of Applied Science, Toronto University. The process of manufacturing this new type of cast iron pipe involves the application of the principle of centrifugal force to molten metal at a high temperature (about 1,800 F.) in a permanent revolving mould. A regulated quantity of this cast iron is introduced into a revolving water cooled cylinder where, by the centrifugal force exerted, the molten metal is spread uniformly upon the surface of the mould. Within a minute the pipe is withdrawn from the mould at a white heat. The pipe is brittle after leaving the mould on account of the outer surface being chilled but after passing through an annealing furnace it becomes tough and much stronger than ordinary cast iron pipe, as shown by the tests made by Professor Gillespie. The pipe made under these conditions has a decided contrast in structure to pipe cast in sand moulds, where the casting is much slower and has not the segregation of impurities often found in the sand-cast pipe. As a consequence, the pipe is a homonegous, dense, fine-grained iron throughout, having no water or gas bubbles, and because of this density and strength the pipe can be made much thinner.

*Paper before Canadian Engineering Institute

†Commissioner of Works, Ottawa, Canada

In tests made by Professor Gillespie, a 6-inch pipe made by this machine was compared with a 6-inch Class C, ordinary sand-moulded pipe and out of the same iron, with the following results:

Centrifugal Cast Pipe	*Sand Cast Pipe*
Thickness, .28 inches	.51 inches
Tensile strength, 37,000 lbs. per sq. in.	16,000 lbs. per sq in.
Modulus of elasticity, 14,500,000	8,860,000
Modulus of rupture, 63,800	33,900
Quality factor, 20.2	9.8

From which it will be seen that the centrifugal pipe has a very high tensile cross-bending and resistance to shock values.

As found by these tests, the ratios of these to other co-efficients similarly found for the sand-mould pipe from the same iron are as two to one, or twice as strong.

In the tests for corrosion made by Professor Gillespie he found no difference, but in tests made at Sao Paulo, Brazil, it was found that the centrifugal cast pipe showed much better results than the sand moulded pipe.

In soils such as found in Ontario, it has been found that ordinary cast iron pipe has very little corrosion. The writer has removed a section of old English cast iron pipe laid in 1859 in Hamilton that showed no corrosion whatever, after being in the ground over 50 years, having even the weight marks clearly legible. This old English pipe was made much thinner than called for in the present day specifications and, being on a rising main, is still in service under more severe conditions from pressure than when laid.

These centrifugal cast iron pipe have a smooth exterior and interior surface, and besides reducing hydraulic frictional losses, take a much better surface coating.

It has been found that they machine easily and, because of the method of manufacture, the wall thickness is practically exactly uniform.

Because of its double strength, the centrifugal cast pipe can be made successfully considerably thinner than the sand-cast pipe, and as a consequence a twelve foot pipe 6 inches in diameter will weigh only 240 pounds compared with 430 pounds for a sand-cast pipe of the same diameter, with the consequent saving in freight rates on shipments of the same quantity of pipe.

This light weight of the centrifugal cast-iron pipe facilitates its laying, as a greater number can be caulked on the ground and lowered into the trench; besides, this latest development in the

manufacture of iron pipe brings it in competition with steel pipe under conditions that had practically limited the field to steel pipe and indicates an advance on previous methods.

Power for Public Utility Plants

The amount of power for public utility plants obtained from water and fuels during the first nine months of 1920, in each of the several states, has been determined and the figures tabulated by the United States Geological Survey. These figures are based on returns from about 3,000 power plants of 100 kw. capacity or more engaged in public service, including central stations, electric railways, and certain other plants that contribute to the public supply. Returns were received from plants the combined capacity of which was about 94 per cent of that of all plants listed.

The total output for the first nine months of 1919 was 28,341,000,000,000 kw. h., while for the same period in 1920 the output was 32,739,000,000,000, an increase of 15.5 per cent. The amount of fuels consumed during the nine months of 1920 totaled 27.7 million short tons of coal, 9.9 million barrels of fuel oil and 18.2 billion cubic feet of gas.

Taking the last month, September, we find that the total kw. h. produced by water power was 1,337,367,000, while by fuels the total was 2,269,997,000. In addition to oil and coal used as fuels, natural gas was used to the extent of 2,699,995 thousands of cubic feet, while wood was used for producing 13,597,272 kw. h. In Idaho, wood was the only fuel used, while the other states using wood were California, Florida, Louisiana, Minnesota, Mississippi, Oregon, Washington and Wisconsin. In Utah only 1,000 kw. h. was produced by fuels in September, but in all of the other states considerably larger quantities of fuel were used.

Some amount of electric power was produced by water power in all of the states except Delaware, Kentucky, Louisiana, Mississippi, North Dakota and the District of Columbia. The greatest amount produced by water power in any one state was 241,876,000 kw. h. in New York, which was closely followed by 224,801,000 in California; both of these figures being for the month of September.

Kansas City's Water Supply Improvement

Kansas City, Kan., has recently received a report from its consulting engineers, Fuller and McClintock, advising as to the extensions and changes necessary to adapt its water supply system to its present and future needs. The plans recommended involve an estimated expenditure of about $18,000,000, of which $1,600,000 is for additions to the distribution system. The plans include revetment and diking on the banks of the Missouri river to protect the site of the proposed plant, an intake founded on rock 80 feet below the river level, a pumping station, grit chambers and a filtration plant, a 7½-foot tunnel 4 miles long bringing the water from this plant to Kansas City, with about 5 miles of additional tunnel for distributing it through the city. The tunnels alone are estimated to cost 4½ million dollars.

A bond election will have to be held in order to raise funds for the work and it is hoped that the matter can be put in shape for submission to the voters in February. The urgent need of extensions to the present water supply system is generally recognized and it seems probable that the vote on the bond issue will be favorable.

Hose Burned by Water Friction

Titles similar to the above have appeared in several of the daily papers, the truth of the statement that the friction of water set the hose afire being vouched for on the authority of J. S. Caldwell, chief engineer of the New England Insurance Exchange. No such statement has been made by Mr. Caldwell, although it is true that the hose did catch fire, that friction caused it, and that water caused the friction.

The real conditions were that a single line of 2½-inch double-jacketed cotton rubber-lined hose, to which was attached a deluge set with a 1¾-inch outlet, was connected to a 750-gallon automobile pumping engine which was maintaining 250 pounds pressure on the discharge gage when the gate on the pump was so throttled that the opening was only ⅜ or ½ inch. The throttling of the discharge produced a stream of very high velocity which impinged against the side of the hose just beyond the coupling. Such was the force of the jet that it caused a slight deflection of the hose at the point of impact and excessive vibration or fluttering of the hose. This fluttering or extension and recession of the deflection caused a rubbing of the jackets together and in two or three minutes the hose at this point became perceptibly warm and in five minutes was so warm that the hand could not be retained against it, which was followed by the distinct odor of heated rubber and the appearance of smoke. This was followed soon by the discoloration of the outer jacket as the cotton was carbonized. The fibers then commenced to fray and part and, as the outer jacket let go, it was observed that the inner jacket was carbonized in the same manner. The total time required to cause the charring and bursting of the hose was approximately 15 minutes.

Following this occurrence, Mr. Caldwell experimented with a centrifugal and a piston fire pump and with two other well-known brands of hose, and from these tests concluded that neither type of pump nor brand of hose was a factor in the occurrence of such incidents; that the position of the gate in the connection must be that necessary to bring the jet caused by throttling it in impact against the hose at a short distance from the gate; that the cause is friction between the inner and outer jackets of the hose produced by vibration or fluttering of the hose at the point where the jet causes a deflection; and that the

conditions under which hose is burned or charred in this way would never be encountered in practical fire department work.

Durability of Metal Irrigation Flumes

Inspection of three miles on the Uncompahgre project indicates certain precautions to be observed in construction of such flumes.

A recent inspection of sixty-nine metal flumes having a total length of 15,735 feet for the Uncompahgre Projects, Colo., has been made during the last season and the results obtained are of interest as showing some of the considerations involved in design, and their durability in service. The circumferences of the flumes vary from 60 to 228 inches, only a small proportion of them being more than 168 inches. The oldest were installed in the fall of 1911 and the latest in the spring of 1920.

These flumes carry water for at least eight months in the year and during the remainder of the time they are alternately wet and dry, according to weather conditions, except as they sometimes fail to drain and continually retain water in the bottom.

The foundations were of concrete, stone, piles and timber bents, all of which were in satisfactory condition except that a few piles had rotted in alkaline soil. Where timber bents were used on adobe soil underlaid with shale, they generally settled from 2 to 12 inches. All piles and timber were creosoted.

All of the sub-structures were of wood, some of them untreated, some dipped in creosote, and some painted. The latter appeared to be in the best condition. The untreated work was weathered and considerably checked. In many instances where dirt and alkali, especially sand or sandy loam had come in contact with the posts and braces, they had decayed so much that it was necessary to cut them off and block underneath them and to replace braces in five or ten years. Treated timber lasts somewhat longer in sandy soil and gives excellent results in adobe soil.

Where considerable settlement was expected, wooden approaches to the flumes were built, and in many cases untreated 3-inch planks had rotted through. The remaining wooden approaches will be lined with concrete. Concrete and stone make the best approaches.

The flumes have been made of steel, of various brands and of No. 20 and 22 gauge, all of them galvanized excepting 250 feet of black metal used for a test.

PAINTING

Out of sixty-nine flumes, fifty-nine were protected by a coat of tar paint on the interior and that which has been applied within the last three years has proved superior to many other kinds of paint tested. The best results were obtained by applying the tar in warm weather to perfectly dry and clean surfaces with heavy brushes or burlap swabs. The joints should be tarred every fall and the entire flume every other fall. On one flume 502 feet long, 550 gallons of tar were used, providing an extra heavy coat, at a cost of 21 cents per square yard for labor and material.

The steel generally fails mostly at or near the joints, although pitting occasionally occurs in the invert. There is more pitting observed near black iron fittings than near galvanized iron fittings. Where the bottom of the flumes was badly pitted it was in several cases repaired by patching with cement bags covered with about 1 inch of concrete.

CONCLUSIONS

In the construction of flumes, careful attention should be paid to foundation and superstructure in order to maintain alignment and to keep superstructure from contact with earth.

Approaches should be warped in order to secure easy transition from canal section to flume section and back again.

The headwall of the approach of large flumes should be constructed to fit shape of flume when loaded.

Ample capacity and freeboard should be provided.

High velocities should be avoided if much heavy silt is carried.

In order to secure long life exceeding, say, 10 years under conditions as prevailing on the Uncompahgre project, the following requirements should be met:

(a) Proper design as to sufficiency of foundation, sizes of bands, washers and cross ties, and a thickness of metal which will obviate excessive deformation.

(b) Thorough galvanizing.

(c) Joints which do not project into the current and which avoid cavitation.

(d) Trapping out of sand and gravel.

(e) Coating with a good quality of coal tar of joints and of inside of sheets as frequently as wear makes necessary, possibly joints every year and inside surface every two, three, or four years.

(f) Provision for temperature changes either in the individual joints themselves or by expansion joints.

(g) Provision for self-drainage.

Philadelphia Begins Municipal Street Cleaning

After forty years of cleaning its streets by contract, during several of the more recent of which it was the only large city that continued this practice, Philadelphia has at last begun municipal street cleaning. Even yet, it is doing only about one-fourth of the work required for cleaning the entire city.

The entire city's area is divided into thirteen street cleaning districts, only two of which, districts 5 and 6, are under municipal operation. The work involved in these two, however, equals nearly one-fourth of the total amount of such work to be done in the city, as it includes the most frequented portion of the city, the retail business district. In this district, the ashes, rubbish and garbage are being collected also by municipal forces. In each of the other eleven districts the streets are being cleaned and the ashes and rubbish collected by a contractor who holds the contract for the year 1921, while the garbage also is being collected by another contractor.

There was much discussion last year as to the advisability of municipal cleaning of streets and collecting of refuse, while the officials themselves stated that it was impracticable to obtain by the first of the year sufficient apparatus and equipment of all kinds for performing such service for the entire city. The director of public works accordingly recommended that the two districts named should be taken care of by municipal operation in 1921 and this plan was adopted by ordinance of council approved November 17, 1920. The director's report gave no intimation of what policy would be adopted after 1921 and it is probable that definite formulation of such policy will be postponed until after several months at least of experience with municipal operation.

Commenting upon this, the Philadelphia Bureau of Municipal Research says: "Objection has been raised from influential quarters to the inauguration of municipal street cleaning because of unfriendliness to the policy of municipal ownership. As has been frequently pointed out, municipal street cleaning is not municipal ownership, but is a municipal service of the same general class as police and fire protection. It is of unmeasurable character and its performance is therefore not properly comparable with the operation of public utilities which furnish measured facilities or commodities."

Graphical Illustration of Municipal Expenditure

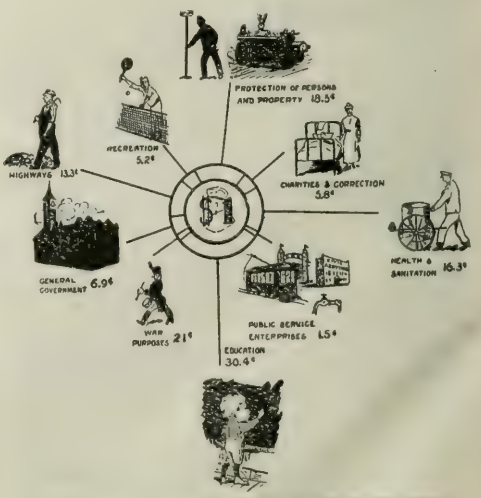
It has become more or less common for cities and other municipal corporations in this country to indicate for the taxpayers the relative amount of each dollar of municipal expenditure that goes for each of several classifications by a circle divided into sectors; but so far as has come to our notice, Toronto, Ont., is the first to supplement this by pictorial indications of the several purposes. From the 1920 issue of 'City Budget Facts," published by the Bureau of Municipal Research of that city, we reproduce such an illustration of the relative amounts paid out for the several public services.

This graphical presentation is supplemented by other diagrams showing expenditures under different classifications and also by tabulated statements classifying the revenues and expenditures. Attention is called to the fact that "departmental estimates are still unstandardized so that it is impossible to tell, from the city's budget, total proposed expenditures for each department and departmental function, analyzed according to budgets of expenditures or things bought, such as personal services, contractual services, heat, light and power, supplies other than heat, light and power, upkeep of structures and equipment." The bureau is convinced that the best administration requires standardized inter-departmental accounts, with standardized methods of estimating, and appropriate control based thereon.

The diagrams compare the gross expenditures analyzed by main functions, by organization units and by objects purchased for the years 1918, 1919 and 1920, respectively. Under the last-named classification the diagram shows that personal services had increased from about $8,000,000 in 1918 to $13,000,000 in 1920, all other expenditures in 1920 totaling $16,250,000, or a little more than the personal services alone, these including supplies, upkeep and depreciation, interest charges, sinking fund charges, etc.

Classified by organization units, it appears that expenditures by the board of education lead with a total of about $6,263,000, next in order being the works department with $5,339,000, the fire department being third with $2,073,000. These were the figures for 1920, which were about one-third greater than in 1918. In 1918 the war expenditure was something over $5,000,000, but this had dropped to less than $500,000 in 1920.

Analyzing expenditures by main functions, education leads with $6,816,000, with protection of persons and property second with a total of $4,250,000, public service enterprises totaled $3,882,000, and health and sanitation, $3,556,000; these all being the figures for 1920.



WHERE EACH DOLLAR OF TORONTO'S TAXES GOES

PUBLIC WORKS

Published Weekly
by
Municipal Journal and Engineer, Inc.
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates

United States and Possessions, Mexico and Cuba....$3.00 per year
All other countries .....$4.00 per year

Change of Address

Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

CONTENTS

ELECTRICALLY DRIVEN CENTRIFUGAL PUMPS AT ST. PAUL 71
Financing Sacramento's Filtration Plant 72
For State-Owned Cement Plants 73
AVENUE U SEWERS, BROOKLYN—Illustrated.. 73
MODERN CAST IRON PIPE—By A. F. Macallum, C. E. 75
Power for Public Utility Plants 76
Kansas City's Water Supply Improvement..... 76
Hose Burned by Water Friction 76
DURABILITY OF METAL IRRIGATION FLUMES 77
Philadelphia Begins Municipal Street Cleaning..... 77
Graphical Illustration of Municipal Expenditure—Illustrated 78
EDITORIAL NOTES 79
Trenching in Wet Ground—Cost-Plus Contracts—Fighting Construction Conspiracies
Obstacles to Construction Operations 80
Construction in 1920 and 1921 81
A Big Construction Company's Encouraging Opinion—Illustrated 81
WHAT DISPOSITION IS BEST FOR CONSTRUCTION EQUIPMENT DURING THE WINTER? 82
LABOR NOTES 83
RECENT LEGAL DECISIONS 84

Trenching in Wet Ground

The article in this issue describing the construc ing of a sewer in a wet, sandy soil in Brooklyn illustrates the advantage of draining such a soil in advance of the major part of the excavation. In this case a small sewer was laid six or eight feet deeper than a large one, at one side of the same trench, and sumps four feet deeper still were installed about every fifty feet. By keeping the sumps pumped down the trench was kept dry for the sewer laying and for most of the excavating.

The general idea is not new, and other methods of de-watering are in use, some of which we expect to describe next week. But by bearing it in mind and adapting it to varying conditions a contractor can often simplify a job and lower its cost. The writer once found excavation for a sewer to be entering a wet, mucky spot which he believed to be a pocket of small area in a clay stratum. By stopping construction temporarily and allowing the water to drain out through the sewer, he was able after a few days to continue the trench through a soil that was only damp and was the easiest of excavation.

In another case a quicksand that swallowed tools and workmen, when drained out, became so hard that blasting was found the cheapest way of loosening it; but by so adjusting the drainage as to leave the sand damp it was excavated with ease while boiling of inflowing water was prevented.

Working in a clay trench where there is considerable water is expensive work. In such cases the water usually enters from the top of the clay stratum, which may be only a foot or two from the surface. By carrying a narrow drainage ditch a few feet back from each edge of the trench, sunk a few inches into the clay and kept a little ahead of the trench, most of the water can be intercepted by these two ditches and the trench kept fairly dry.

Most of these expedients cost money, but less than that lost by the miring of workmen's feet in clay, the extra handling of sand carried into the trench through or under the sheeting, the deposits of such sand in the conduits under construction, etc. In conditions of this kind a little brain work may save many dollars and perhaps lives.

Cost-Plus Contracts

The cost-plus contract is an excellent one in the proper place and when properly executed; in the wrong place or badly executed it may become very objectionable.

In the late war emergency it was necessary although generally as an admitted choice of evils. It there served its purpose and undoubtedly was a great advantage, far exceeding the disadvantages and abuses chargeable against it. Many of the best and most upright contractors executed their work under its provisions with the utmost fidelity, fairness and efficiency. Others faithfully endeavored to do the same but were unable to wholly eliminate the abuses to which this system is open. Still others deliberately took advantage of these opportunities for unfair and unjust practices and dishonest profits, but these were in a very small minority in the important federal construction operations.

With the reconstruction period and a return to normal conditions, the cost-plus form of contract will be less and less necessary and under ordinary conditions will justly be viewed with distrust. It is true that it is ideal on the basis of 100 per cent ability, efficiency and scrupulous integrity, economy and disinterestedness of all concerned, but when these are all assured the millenium will have been far spent, and there will be little need for contracts or legal obligations. At present average human nature is too weak to withstand a universal opportunity for authorized advantages at the expense of the other party.

Cost-plus contracts do not lend themselves readily to full competition, are very complex and indefinite in their responsibility, and invite ex-

travagances without offering any inducement for economy or efficiency.

Most high-class contractors and all private owners or corporations prefer free competition and lump sum, unit price, or sliding scale compensation contracts, and the contractor is entitled to profit by his ingenuities and economies rather than by his extravagances.

Fighting Construction Conspiracies

The fight against corruption, conspiracy and profiteering that has hamstrung construction and vital improvements that are sorely needed in this country, should be pushed to the utmost without regard to political considerations. If this is done, the evils, long known and suspected, will be disclosed and can be eliminated. If they are properly dealt with the improvement, now under way, of conditions in the construction field will be greatly accelerated and delayed operations will go forward so rapidly and continuously that a long era of high prosperity will result.

It all depends on the sincerity of the wish to cure these evils and the vigor and thoroughness with which the investigation is continued and adequate legal action is taken in accordance with its results.

The Lockwood Committee, the district attorney, the honest dealers, contractors, labor unions and the general public should support the investigation heartily and demand its fullest and most rigid operation, shielding no one and adequately punishing all that are found guilty.

We hope and urge that this may be the case, even if influential and hitherto respected parties are found guilty and suffer.

At this stage of the proceedings it is difficult to tell whether some of the irregularities may have been justifiable expedients to fight conspiracies already formed, but in no case can they excuse unjust or dishonest practices, gross profiteering, intimidation and violence that have been uncovered. The production and distribution of important universal staples is a public matter that does not permit of discrimination against individuals or localities and should be considered as are public utilities. The imposition of trivial fines and dismissal with mild reproof will be no deterrent for the future, and even if it checks the present offenders, new men and new methods will speedily resume the old practices if they are not severely punished and made impossible in the future. Jail sentences, if authorized by the law, maximum fines, the dissolution of illegal combinations and the most public exposure and censure of offenders are needed.

The honest and loyal citizens that form a large proportion of the labor unions undoubtedly wish their organizations to be clean and honest and should insist on the most searching investigation of their leaders, representatives, and agents and the deposition and severe punishment of all that are guilty of unfair practices, of collusion or even toleration of the methods of Brindell and others of his kidney.

The unions which, properly conducted, may be desirable organizations, can by no means afford to endorse or participate in any manner in these crimes. Neither should they tolerate for a moment any disposition to condone or ignore them, much less to conceal or defend them as some radicals do.

Obstacles to Construction Operation

Editor, Public Works,
243 W. 39th Street,
New York City.
Dear Sir:

I have read the letter from Mr. Connors and the editorial concerning it and wish to commence by congratulating Public Works on taking up this matter, which is one that cries aloud for reform.

I am in essential agreement with Mr. Connors, but would like to further emphasize the desirability, from the viewpoint of both the owners and contractors, of the cost plus a fixed fee basis, modified with a profit and loss sharing arrangement by which the contractor shares both expense and savings on either side of an accepted cost estimate.

There are many pieces of work on which, owing to various causes, it is impossible to give a close price that is fair to the owner and yet takes into consideration the risks run by the contractor. Such contracts are well covered by the cost plus a sliding fee, since competition is by no means eliminated by this method.

If each bidder submits his estimated cost and states the basis on which he is willing to share the losses, as well as to participate in the profits due to his estimate being under or over the actual amount required, then competition can be made and the work awarded on a competitive basis.

It is impossible, at the present time, for either employers or employed to be prosperous in the contracting business, and for this I think the chief blame can be laid at the door of labor, both organized and unorganized. I speak as a friend of organized labor, since I have always maintained that well-conducted unions are helpful to the success of a contractor, giving him a sufficiency of properly trained and qualified men. It is hard, however, for any employer of labor to feel any sympathy with the demands that have been made on its behalf during the last few years, and still harder to find any excuse for the undoubtedly reduced efficiency shown.

A thorough investigation is necessary. That the interest of the public should be aroused is also necessary and in arousing such interest, the press is the greatest power for good of any agency existing.

In bringing this matter into your columns I therefore feel that you are doing a service to employers of labor and to labor itself, and in consequence, to the country at large.

If labor can once be educated to understand and appreciate that its well-being is absolutely bound up in the prosperity of the employers, the end of hard times will be well in sight.

I believe that the majority of employers of labor realize that the well-being of labor itself is absolutely necessary to the success and prosperity of their own undertakings.

Very truly yours,
MacArthur Concrete Pile & Foundation Co.,
By D. McG. Newton,
Vice-President and General Manager.

Editor, Public Works,
243 W. 39th Street,
New York City.
Dear Sir:

Your editorial statement in the issue of January 15, "that the investigation (of the Lockwood Senate Committee) should be most thorough and impartial and all misdoings should be exposed and punished and measures taken to prevent their recurrence" is in complete accord with my sentiments and I want to take this opportunity of commending you for your excellent editorial on the situation.

Very truly yours,
C. A. Crane,
Secretary of the General Contractors' Association.

Construction in 1920 and in 1921

The F. W. Dodge Company's review of building activity says, in part: "The amount of money involved in construction contracts during 1920 in the twenty-five northeastern states of the country was practically the same as in 1919. On account of greatly increased construction costs, this amount of money, something over two and a half billion dollars, paid for a volume of construction that was nearly one-fourth less in 1920 than in 1919.

"The year 1920 opened with a rate of construction activity unprecedented for the winter season. Total contracts reached a maximum of over three hundred million dollars in the month of April. From that time on, for causes well known generally, activity declined more or less steadily to the end of the year. December contracts amounted to one hundred million dollars.

"In normal years the total estimated cost of contemplated or projected work reported is about 50 per cent in excess of the total amount of contracts awarded. In 1919 the total of projected work was 68 per cent in excess of contracts awarded; in 1920 it was 92 per cent in excess of contracts awarded. These figures give an indication of the amount by which each of the two years has run behind its announced construction program.

"In an analysis of the present price situation, a well-known authority has stated that the upward turn in material prices will probably occur some time in 1921 and that, in consequence, building costs in 1921 will be somewhat lower than they have been in 1920 or will be in 1922 and 1923.

"A volume of construction equal to that of 1919 on a cost basis somewhere near the 1919 level may be given as the most reasonable forecast for 1921. In money this would involve about two and a half billion dollars for the twenty-five northeastern states of the country, the same as the figure for 1920, though on a cost level that should represent a volume approximately one-third greater than the 1920 volume of construction.

"In 1921, residential construction and the construction of public works and utilities may be expected to predominate over other classes of buildings."

A Big Construction Company's Encouraging Opinion

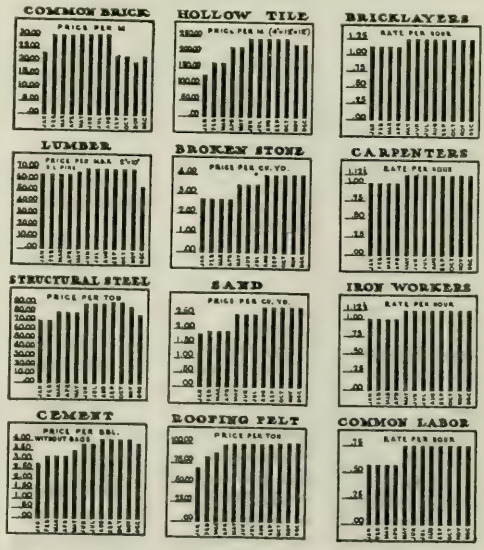
The George A. Fuller Industrial Engineering Corporation, in a review of building conditions in New York City, finds an increase during 1920 in the prices of all the principal construction materials, and of wages for mechanics. During the last part of the year, some material prices have dropped, but none except that of lumber have reached the 1919 level, and there has been little drop in the prices of cement and hollow tile and none at all in the exorbitant prices for sand and broken stone, raw materials that involve little more necessary cost than that of quarrying, crushing or screening and transporting. In wages there has been no reduction whatever in union rates.

"We look for a stabilization of material prices at lower levels in the late spring and early summer, when building activity will be revived under the encouragement of these lower prices. Some upward trend, even, may result from this increased building program, but 1920 peak prices will certainly not be seen again.

"The beginning of 1920 found wages in the building trades also high, and on May 1 there was a wage increase in practically every trade. Those not raised on May 1 were advanced on October 1, so that wages in all building trades are higher today than a year ago. In the face of a marked and continuing decline in living costs and a reduction in wages in many other lines of industry, the present wage scale cannot be justified much longer. A softening of the scale is already evident in unorganized and common labor circles. Union labor, however, operates under term agreements which fix the wage scale for definite periods. It will resist any wage decrease to the last, but it must unquestionably adjust itself to the new conditions.

"Contractors, like manufacturers, are rejoicing in the decrease in labor unit costs, due to the marked increase in the efficiency of labor, even though the wage scale is not changed. Whether this increased efficiency will be sufficient to keep wages at their present levels, however, is doubtful

"The Lockwood Committee investigation has had a very healthy influence on the building business. Temporarily it has tended to check construction, and certainly has revealed some ugly conditions, but this much-needed surgical operation will leave the business as a whole cleaner and healthier than ever before."



MONTHLY PRICES OF BUILDING MATERIALS AND OF LABOR IN 1920.

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems different will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one

What Disposition is Best for Construction Equipment During the Winter?

Winter work should be provided for permanent force, all plant and supplies inspected, appraised, scrapped or repaired and stored. New units made and schedules, bills and plans prepared for new and unfinished work.

In localities where the winters are cold and stormy, general contractors usually find construction operations very much limited or suspended for several months and should make provision in advance for the proper care of their plant and equipment when out of service, and to utilize the opportunity for doing special work that is likely to be neglected during the busy season as well as to make preparations for the future and perfect plans to reduce the cost and to expedite or improve new and unfinished work.

SPECIAL NEW WORK

An energetic contractor may often by special effort secure a considerable amount of work that can be done in the winter as well as in the summer and by careful planning can arrange to employ on it a considerable portion of his plant and equipment and part, at least, of his force, so as to maintain the better portion of his organization, secure a return on his investment, and reduce the cost of overhead.

Quarrying rock, excavation, some kinds of grading, most tunnel work, logging, clearing, and any kind of shop work, repairing or manufacturing that can be done under cover are likely to be available in the winter when, in many quarters, the number of unemployed is maximum and men can be secured more readily and will work better and for lower wages than in summer. These advantages are likely to outweigh the shorter and darker days, the obstructions by snow and ice, and the disadvantages of extreme cold.

In snow countries hauling may be done with teams where the roads are rough or where there are none at all, to much better advantage when the ground is covered with snow than when it is not, rivers and lakes may be crossed on ice where ferriage is difficult in summer, and very smooth, level tracks may be laid out on the ice to temporarily replace crooked, hilly, rough highways. When the ground is frozen hard it may also be possible to get access to and perform certain operations in swampy places that are difficult to negotiate in the summer. For heavy manual operations cold may not be objectionable if it necessitates constant activity to keep the men warm.

If the contractor can easily secure shed room or any suitable empty building he may often be able to make drain pipes, curbs, ornamental or dimension trimmings, or other articles of concrete that require careful finish in comparatively small forms or are made in great quantities that might otherwise be made on the work. He may also pre-cast in advance beams, girders, floor and roof slabs, etc., on the unit construction plan instead of casting them integral, in situ, thus saving much time.

In very cold weather it is found that some items of mechanical plant subject to heavy duty, especially steam shovels, are much more likely to injury and breakage than during moderate or warm months, so that many experienced contractors prefer to lay their steam shovels up entirely during January and February rather than do a small amount of work and sustain considerable damage.

CARE OF PLANT

All mechanical equipment should be housed either on the job or at the contractor's yard or shop, and if this is impossible it should be thoroughly secured and protected from storm, flood, theft, mischief or any kind of disturbance, detachable portions removed, and the remainder covered with canvas or equivalent. All portions likely to rust should be thoroughly oiled or greased.

Plant operated by steam, compressed air, or electricity, such as locomotives, hoisting engines, air compressors, pumps, rock drills, concrete mixers, and the like, should be thoroughly inspected, their bearings cleaned, oiled and adjusted, cylinders examined and packed, valves ground and set, and the machines tested, oiled and adjusted ready for immediate use when called for. Boilers should be emptied and thoroughly cleaned, the scale removed, the tubes examined, new grates furnished if necessary, safety valves overhauled, connections examined and the boilers tested by pressure in excess of their working load. Careful lists

should be made of broken or defective parts and these as well as any extras required should be ordered promptly to avoid delay later on. If the machinery is very badly worn it may be better to scrap it before attempting to repair it, merely saving more valuable parts, such as valves, gauges and the uninjured parts for repairs and extras for other plant. If no farther use is anticipated for it, it should be overhauled with a view to selling it at the first satisfactory opportunity. Special care should be taken to have it look neat and be well painted, attractive in appearance, easily accessible and in good running order for demonstration, and it should be advertised for sale and immediate delivery.

All derricks should be taken down and dismantled, the rigging very carefully overhauled, inspected and tested and all necessary repairs and renewals made. Steel derricks should be carefully inspected for bent places, injured plates, lattice bars or rivets, and should be thoroughly painted. Wooden derricks should be very carefully examined for cracks and decay, especially around the fittings, but should not be painted. The blocks, sheaves, spiders, links, clevises, hooks and bearings should be carefully examined and well greased or lubricated, the steel or manila cables should be unrove and every portion very carefully inspected for broken or frayed strands, and all serious defects should be cut out. Cables should be tied up in coils and marked with the size and length of rope and the derrick to which it belongs. Steel cables should be well covered with a preservative coating. Guy ropes should be carefully separated from hoisting ropes and much-used or old ropes from new.

Wheelbarrows, dump cars, skips, wooden buckets, wagon boxes, car trucks, running gears, batch boxes, and the like, should be overhauled and repaired and in many cases new ones can be advantageously made, using some of the old parts and trimmings, if good enough, to provide for the regular or increased quantity next season.

All hand tools should be assorted, put in order, and stored on shelves, in bins, or in portable boxes ready to be sent out on the job. Where there is much plant involved, a good machinist with a few simple standard machine tools operated by steam or electricity, a blacksmith, and a carpenter, with sufficient helpers, can be very profitably employed putting all of the equipment in first-class order and saving much that otherwise would be lost or destroyed.

A simple Telfer system with a differential chain hoist mounted on a trolley, traveling on a convenient overhead track made of angles, I-beams, channels, or even of wooden joists, can be installed at little expense and save much time and labor in handling heavy pieces in the storage and shop. The storage house should be provided with bins, shelves and hooks for keeping all supplies, equipment, and extra parts, and an accurate description and inventory, with prices or values, should be kept and depreciation posted, as articles are brought in or out and credited or charged.

Employment can be found for some of the office force in making estimates, bills of materials for new and unfinished work and in preparing the orders in advance so that they are ready to issue as soon as it is expedient to make the purchases. Drawings, sketches and complete working plans and descriptions of methods for improved operations can be studied and prepared, and details worked out for home-made contrivances and equipment. Any work of this nature that can be done in advance and unhurriedly in the comfortable, convenient office will be found to be much cheaper and more satisfactory than if done in an emergency or under difficulties on the job, since mistakes and experiments are far cheaper on paper than in the field.

Wherever it is possible, the methods and operations should be studied in advance and a complete schedule prepared showing just when each operation should be begun and ended, how many men are required, what plant, tools, machinery, materials and supplies are necessary, when and where they should be delivered and in what quantities. This can be combined with or added to a progress sheet posting the state of the work by very simple checking or marking with colored pencils daily so as to show essentials instantly by inspection and will be found very useful and satisfactory for any job that requires different kinds of work and material. It will directly save time and money and will encourage and stimulate the men and materially assist the superintendent.

Labor Notes

Increased efficiency of sawmill and woods labor in all sections of the south is reported by the Southern Pine Association. Notwithstanding reductions which have been made in the number of men employed by the companies, an increase in the output is shown. The number of colored men seeking work is much larger than heretofore, this being attributed to the fact that the negro is gradually realizing that he does not fit into northern industries and is returning to his old clime.

The increasing number of reports of mill and factory shut-downs and part-time work, together with the announcement of reduction in wages made by many large employers, notably the Bethlehem Steel Company, textile works, garment makers, many rubber companies, the Pullman Company, and other concerns together employing hundreds of thousands of men that have reduced prices up to 25 per cent, is bound to have a wide-spread effect and in some places the employees recognize the signs of the times and have consented and even offered to accept the reduction cheerfully rather than be thrown out of employment. Even the bricklayers' union of Springfield, Mass., consents to starve along on the present rate of $1.05 per hour until next April, when their demands for $1.50 per hour will be renewed.

Recent Legal Decisions

OFFICERS ELECTED UNDER UNCONSTITUTIONAL CHARTER PROVISIONS ARE DE FACTO OFFICERS

The Michigan Supreme Court, in a proceeding to test the validity of the voting system for electing members of the governing body of the city of Kalamazoo under a recently adopted charter, Wattles v. Upjohn, 179 N. W. 335, holds that all city officers legally nominated and formally found elected under color of the voting system provided in the charter, who qualified and acted as such, were and are de facto officers whose official actions within the scope of the charter are valid until they are formally deposed from such positions.

ASSESSMENT NOT INVALIDATED BY OMITTING RAILROAD NOT BENEFITED

The California Supreme Court holds, Bailey v. City of Hermosa Beach, 192 Pac. 712, that an arrangement between a city and a railroad company that a street improvement should be without expense to the company does not invalidate the assessment of other lands where it does not have the effect of throwing onto them a portion of the expense which they should not bear, and also where the company's lands were not benefited. Of course, if the railway company's lands would be benefited by the improvement so that a portion of its expense should be assessed against them, then the arrangement would have to be carried out in some other manner than by failing to assess those lands.

PRINCIPLES OF ASSESSMENTS FOR IMPROVEMENTS

Many decisions by courts of last resort, including the Supreme Court of the United States, establish the following principles respecting taxation for improvements: It is competent for the Legislature, under the taxing power, to determine the area of property benefited by the improvements for the purpose of establishing a tax district unless, as said in Branson v. Bush, 251 U. S. 182, it is "arbitrary" and "wholly unwarranted"—"a flagrant abuse, and by reason of its arbitrary character a confiscation of particular property." The property owners within the area of assessment are not entitled to be heard upon the question of the creation and limitation of the district, but they are entitled to be heard upon the apportionment of taxes within such district. It is competent for the Legislature to create a tax district for the purpose of raising money to pay for improvements already made, and likewise to substitute the tax district for another. The Legislature may also determine the basis of assessment, whether it shall be on area, on value, on location with reference to the improvement, or on any other reasonable basis that the Legislature, in the exercise of its discretion, deems to be just and equitable. Valley Farms Co. v. City of Yonkers, 184 N. Y. Supp. 300.

COMPELLING REMOVAL OF CAR TRACKS TO CENTER OF STREET—PAVING BETWEEN TRACKS

The North Carolina Supreme Court holds, City of Raleigh v. Carolina Power & Light Co., 104 S. E. 462, that where the boundaries of a city are extended to include a highway along one side of which street railway tracks run, the city may, both under a provision in the franchise to the company that the tracks shall be located wherever practicable in the center of all streets, etc., and under the city's general police power over the streets, require the tracks to be removed to the center of the street, the safety of the citizens requiring that street car tracks shall be in the center of the street in cities and towns. Under an express provision of a franchise that the company shall pave the space between the tracks when the city shall pave the streets, a city can compel a street railway company to pave the space between the tracks after such extension of the city boundaries. This also would be a proper exercise of the police power, as it is as necessary for the safe and convenient use of the street to pave the space between the double track as to pave the space between each individual track.

STATUS OF MUNICIPAL BOARD OF WATER WORKS AND LIGHT

The Georgia Supreme Court holds, Dobbs v. Brumby, 104 S. E. 440, that under the Georgia statute of 1906, creating a board of lights and waterworks in the city of Mariette, and making it a body corporate with powers incidental to the discharge of its duties, with the right to sue and be sued and giving it charge of the water supply for the city, with the power to contract therefor, and for light, to regulate the rates, to contract with other companies, and to handle proceeds of bonds, the board was a subsidiary or auxiliary commission of the city. When the board contracted to purchase a competing company's franchise, good will, contracts with its customers, and certain physical property, and to pay the price in installments through a series of years, and from money illegally borrowed, it created a prohibited debt within the Georgia Constitution.

CITY HELD NOT LIABLE TO CONTRACTOR FOR INTEREST ON BANK DEPOSIT

In a contract for construction work between a city and a contractor there was no provision requiring the city to keep separately money coming to the contractor. The Massachusetts Supreme Judicial Court therefore holds, Goldman v. City of Worcester, 128 N. E. 410, that the title to its bank deposit remained in the city, which sustained no fiduciary relation to the contractor; and the latter could not claim the proportionate part of interest on the city's deposit which accrued while moneys due him were held up pending the determination of lien claims.

NEWS OF THE SOCIETIES

Jan. 25—NEW JERSEY STATE ASSOCIATION OF COUNTY ENGINEERS. Annual meeting. Engineers' Club, Trenton, N. J.

Jan. 25 — ATLANTA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with Atlanta Section, A.S.C.E. Carnegie Library.

Jan. 25 — PHILADELPHIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Engineers Club of Philadelphia.

Jan. 25-27 — MICHIGAN ENGINEERING SOCIETY, STATE ASSEMBLY OF THE A.A.E., Detroit, Mich.

Jan. 25-27 — THE AMERICAN WOOD PRESERVERS ASSOCIATION. Place of meeting to be announced later.

Jan. 25, 26, 27—ASSOCIATED GENERAL CONTRACTORS. Annual meeting, New Orleans. Secretary's Office, Washington, D. C.

Jan. 27-28—INDIANA ENGINEERING SOCIETY. Annual meeting, Indianapolis. Secretary, Charles Brossman, Merchants Bank Building.

Jan. 28 — COLORADO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Metropole Hotel.

Jan. 31-Feb. 5—NATIONAL BRICK MANUFACTURERS' ASSOCIATION AND COMMON BRICK MANUFACTURERS' ASSOCIATION OF AMERICA. Joint meeting. Hotel Pennsylvania, New York City.

Feb. 1-2—NEW YORK STATE ASSOCIATION OF BUILDERS. Convention. Rochester, N. Y.

Feb. 1, 2, 3—ONTARIO PROFESSIONAL MEETING in conjunction with the annual meeting of the Engineering Institute of Canada. Toronto.

Feb. 1 — CLEVELAND SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Cleveland Engineering Society's rooms.

Feb. 8 BOSTON SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Feb. 7-8—FLORIDA ENGINEERING SOCIETY. Annual meeting. Lakewood, Fla.

Feb. 9-12 — AMERICAN ROAD BUILDERS' ASSOCIATION. Eighteenth annual convention, eleventh American Good Roads Congress and twelfth National Good Roads Show, Coliseum, Chicago, Ill.

Feb. 11-12 — ENGINEERING SOCIETY OF WISCONSIN. Annual meeting, Madison. Secretary, Leonard S. Smith, Madison, Wis.

Feb. 14-16 — NATIONAL CIVIC FEDERATION. 21st annual meeting. Hotel Astor, New York.

Feb. 14-16 — AMERICAN CONCRETE INSTITUTE. Annual meeting. Auditorium Hotel, Chicago, Ill. Secretary, Harvey Whipple, New Telegraph Building, Detroit, Mich.

Feb. 16-18 — AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Seventh midwinter convention. Engineering Societies' Building, New York City.

Feb. 28 — PHILADELPHIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Engineers' Club of Philadelphia.

May 9-11—AMERICAN ASSOCIATION OF ENGINEERS. 7th annual convention Buffalo.

May 17-19—NATIONAL FIREMEN'S ASSOCIATION. Twenty-third annual convention Fort Wayne, Ind.

June 7-9—NATIONAL FIRE PROTECTION ASSOCIATION. Annual meeting. San Francisco, Cal.

June—CONFERENCE OF MAYORS AND OTHER CITY OFFICIALS, State of N. Y. 12th Annual Conference. Elmira, N. Y.

June 6-10, 1921—AMERICAN WATER WORKS ASSOCIATION. Annual convention at Cleveland, Ohio. Secretary, J. M. Diven, 153 West 71st St., New York.

Oct., 1921—IOWA SECTION, AMERICAN WATER WORKS ASSOCIATION. Seventh annual meeting. Omaha, Neb.

THE NATIONAL CIVIC FEDERATION

The twenty-first annual meeting of the National Civic Federation, Judge Alton B. Parker, president, and Samuel Gompers, vice-president, will be held February 14, 15 and 16 at the Hotel Astor, New York.

Outstanding industrial problems, with which the American people are confronted to-day, from both the national and the international viewpoints, will be discussed and it will be endeavored to secure impartial consideration of existing facts, conditions and requirements involving the mutual or divergent interests of capital and labor, industry and finance.

The program for the federation's annual meeting will include, in addition to topics indicated by the problems presented in the foregoing, reports from its Workmen's Compensation Department, Social Insurance Department, and especially the new Department on Study of Revolutionary Movements. During the past year through fifteen sub-committees the last named department made an extensive study of the extent to which the revolutionary forces in this country have penetrated the various groups making up our citizenry: labor, agriculture, the church, the college, the public school, philanthropic agencies, negro and foreign groups, and women's organizations. This investigation has resulted in some amazing revelations which call for most serious consideration by those who believe that the institutions of our country should be safeguarded against the "boring from within" policies of the Socialists, I. W. W.'ites and Bolshevists.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The American Society of Mechanical Engineers has formed a Material Handling section. About 700 members of the society have been enrolled, although only a small part of the society's membership has been formally notified of this professional section.

The executive committee of the section, consisting of R. M. Gates, chairman; H. V. Coes, Kern Dodge, Nathan C. Johnson and F. A. Wardenberg, has issued a statement saying that great potential interest has been aroused in the bringing together of individuals who desire to help in solving the handling problems of mining, transporting, manufacturing and distributing of all materials.

The executive committee in its preliminary study of the proposed activities of this section is considering the advisability of organizing committees, as required by the amount of work in the province of each, along two entirely separate lines: 1. According to types of material handling equipment, such as conveyors, cableways, cranes and the like; 2. According to industries which have material handling problems, such as steel manufacturers, storage warehouses, commodity distribution centers, construction work, automobile or tire industries and the like.

It is the intent of the section to thoroughly discuss the controlling factors in each line by meetings held by these various committees so as to develop better methods of handling materials and to standardize equipment and methods where the same are desirable.

DENVER CONTRACTORS TO JOIN ASSOCIATED GENERAL CONTRACTORS

Denver contractors and engineers recently organized with a view to associating themselves with the A. G. C. of America. They will send representatives to the New Orleans meeting of the association on January 25-27.

IOWA ENGINEERING SOCIETY

The thirty-third annual meeting was held at the Chamberlain Hotel, Des Moines, Ia., January 18-20, 1921. The principal features besides routine business were as follows:

First session of the section on Drainage Engineering, "Design of Sizes of Tile Drains," D. L. Yarnell, Washington, D. C., senior drainage engineer, Bureau of Public Roads. "Determination of Maximum Run-offs from Stream Gaugings," E. D. Burchard, Ames, Water Resources Branch, U. S. Geological Survey, in charge of work in Iowa. "Some Special Problems in Open Ditch Design, with Particular Reference to Prevention of Silt Deposits," Q. C. Ayres, Ames, Agricultural Department, Iowa State College.

Second session of the section on Drainage Engineering, "Hydraulic Fill Dams and Levees," S. M. Woodward, Iowa City, professor of Mechanics and Hydraulics, University of Iowa. "Quality Requirements in Drain Tile Specifications—Concrete Tile," R. W. Crum, Ames, Materials Engineer, Iowa State Highway Commission. "Quality Requirements in Drain Tile Specifications—Clay Tile," S. L. Galpin, Ames, Ceramics Department, Iowa State College. "The Location and Design of Surface Inlets in Tile Drains," C. E. Gross, Eagle Grove, Drainage Engineer.

Iowa Engineering Society—Address of Welcome, by K. C. Kastberg, Des Moines, president, Engineers' Club of Des Moines. President's Address, by H. H. Dean, Council Bluffs, county engineer, Pottawattamie county. "The Cost Factors of Engineering Practice," C. H. Young, Muscatine, president, Central States Engineering Company. "Cost Keeping on Construction Work," F. H. Austin, Webster City, secretary, Currie Engineering Company. "Contracting as a Profession," F. C. Young, Waterloo, Moore-Young Construction Company.

Third session of the section on Drainage Engineering — Experience meeting—topics: Clean-out Work; surveys, plans and specifications, construction equipment and methods, cos's Drainage District Surveys and Maps—surveying methods, data shown on

map, completeness of detail. Bases and Methods of Estimating Costs—of tile, hauling, labor, and backfilling; of open ditches; of levees; of construction engineering services. Unusual Repair Work—nature? how made? how successful? Drainage Specifications—what should be required? how enforced? Experiences—for tile work; for open ditches; for levees. Drainage contract provisions—submission of bids; contractor's bonds, amount, actions and collections under; force account vs. cost plus work; payments; engineer's authority and responsibility. Office Methods and Forms for Drainage Engineers. Inspection and Tests of Drain Tile.

Section on Highway Engineering—"Primary and Secondary Road Assessments," F. W. Parrott, Ames, auditor, Iowa State Highway Commission. "General Discussion on Primary and Secondary Road Assessments—Some Recent Observations of Pavement Failures," T. R. Agg, Ames, professor of Highway Engineering, Iowa State College. Question Box and Round Table Discussion—topics: Dirt Road Construction and Maintenance. Building Roads with Available Materials. Cost of Permanent Highway Bridges. Road Design. The Iowa Road Construction Program in 1921.

Section on Municipal Engineering—"Pavements," M. L. Patzig, Des Moines, consulting engineer. "The City Manager Plan," O. E. Carr, Dubuque, City Manager of Dubuque. "Water Supply in Iowa," J. J. Hinman, Jr., Iowa City, Senior Bacteriologist and Chemist, State Board of Health. "Rates of Excessive Precipitation in Iowa," M. I. Evinger, Des Moines, civil and sanitary engineer.

Question Box and Round Table Discussion—topics—The Actual Life of City Pavements. Operation of Sewage Treatment Plants. Relation of Landscape Architects to Engineers. Standardized Building Codes and Ordinances for Iowa. Office Procedure and Management by the Engineer.

Fourth annual camp fire; informal discussion. Topics—Our District Clubs; The Engineering Barometer.

Inspection trip to points of interest in Des Moines. Annual rump convention. Informal banquet and dance at the New Savery Hotel.

ASSOCIATED GENERAL CONTRACTORS ASSOCIATION

The second national conference will be held at the Hotel Grunewald, New Orleans, La., on January 25, 26, 27, 1921.

January 25, papers will be presented by the leading architects and engineers of the country on the most vital subject before contractors, viz.: "Contracts, General Conditions and Specifications." In order that the various types of construction will be fully covered, the papers, and their subsequent discussion, will be carried on simultaneously in four groups so that building contractors, highway contractors, railroad contractors, public work contractors will have full opportunity to tell their troubles and help find solutions for them.

Wednesday morning, January 26, is set aside for a business session for the whole association. The report of the executive board will be made and plans for the future development of the A. G. C. will be presented for discussion. There will be a boat ride in the afternoon on the Mississippi river and moving pictures, beginning at 8 p. m., showing latest construction methods.

Thursday, January 27, the different groups of contractors will have an opportunity to listen to such important subjects as: Compensation Insurance; Relations with Sub-contractors; Why Highway Contractors Lose Money; Immigration, and Should Unlimited Competition Be Continued on Public Works. In the afternoon is the final general meeting to act on resolutions, elect a nominating committee and greet the newly elected officers.

The entertainment features of the program are the following: On Tuesday, January 25, at 8 p. m., a smoker, entertainment and refreshments—stag and a big time; also a theater party for ladies; on Wednesday, January 26, at 2 p. m., a boat ride on the Mississippi river for members, guests and their families; on Wednesday at 8 p. m., moving pictures showing latest methods in construction; and on Thursday, January 27, at 7 p. m., the annual dinner.

THE ENGINEERS' CLUB OF PHILADELPHIA

The subject for the regular meeting of Friday, January 7 was "The Development and Future of Handling Freight by Motor Trucks."

Mr. F. W. Fenn, secretary of the National Motor Truck Committee, of New York City, addressed the meeting on "Better Highways and Motor Transportation As an Aid to Production." Mr. M. O. Eldridge, Director of Roads, A. A. A. Good Roads Board, of Washington, D. C., submitted a paper in regard to a rather unique motor truck line established within the past year and operating very successfully between Washington and points in southern Maryland.

On December 21, the regular meeting of the Engineers' Club was held at 8:15 p. m. Minutes of the regular meeting held November 17 were approved. The tellers reported that 226 legal ballots had been received on the question of amending Article IV, Section 19; Art. VI, Sec. 7; Art. VII, Secs. 1 and 2; Art. VIII, Sec. 10; Art. IX, Secs. 2, 6 and 7; and Art. XIII, Sec. 2, of the By-Laws and that all these amendments as proposed had been approved.

On the subject of "Road Construction for Heavy Truck Traffic" a communication from Major J. M. Ritchie, Quartermaster Corps, U. S. Army, was read; Mr. Earl B. Smith, Senior Assistant Testing Engineer of the Bureau of Public Roads, Department of Agriculture, Washington, D. C., gave the results of recent tests and calculations of impact on roads by trucks with varying loads and speeds; Mr. Childs, representing Mr. John W. Mackall, Chief Engineer, Maryland State Roads Commission, read a paper on "Limiting Truck Traffic to the Size, Weight and Speed Which the Roads Can Withstand"; Mr. H. Merkell, Jr., secretary of the Motor Vehicle Conference Committee of New York, on a "Uniform Vehicle Law"; Mr. Prevost Hubbard, Chemical Engineer of the Asphalt Association, New York, on "Some Considerations Governing the Design of Pavements for Heavy Traffic"; Messrs. C. M. Pinckney, Chief Engineer of New York City, R. Keith Compton, Chief Engineer of Baltimore, W. G. Thompson and J. E. Morris, of New York, took part in the discussion. Above papers, with illustrations and discussions will be published in an early number of *The Journal*.

BROOKLYN ENGINEERS' CLUB

At the regular meeting of the Brooklyn Engineers' Club on January 13, 1921, a paper on "Electrification of Staten Island Railroads," presented by Randolph H. Nexsen, electrical engineer for the Public Service Commission, outlined Staten Island Transportation Conditions, Proposed Electrification of Rapid Transit System Serving Richmond Borough only and not connected with City Rapid Transit System; gave transportation facilities and statistics, and suggested self-contained rapid transit plan designed for ultimate connection with the city rapid transit system.

BROOKLYN ENGINEERS' CLUB

The paper announced for the meeting of Feb. 3 will be presented by T. Kennard Thompson on the "Canalization of the St. Lawrence River and Development of Water Power of the St. Lawrence and Niagara Rivers." Lantern slides will be used and as there is much of general interest in this project, ladies are invited to be present at the club house, 117 Remsen street, near Borough Hall at 8:30 p. m.

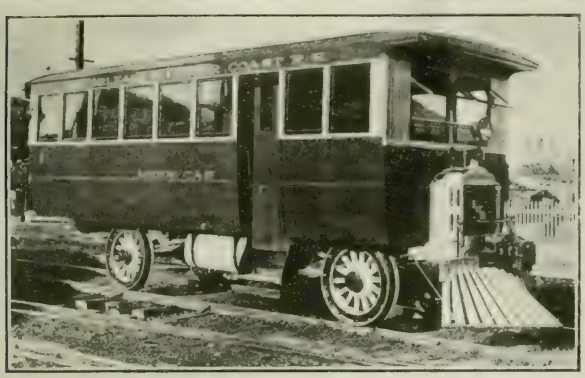
NATIONAL CONGRESS OF BUILDING AND CONSTRUCTION INDUSTRY

Plans are now being perfected for convening the first session of the National Congress of the Building and Construction Industry to bring together general contractors, sub-contractors, and workers in the building trade, architects, engineers, producers of and dealers in building equipment. It is proposed to make a scientific survey of the needs of the workers and the methods of training them and of the sources of supply of raw materials and manufactured products and to determine the national construction requirements for 1921 and future years.

At a conference held in Atlantic City, August 6, 1920, the representative architects, contractors, sub-contractors, engineers, labor men and manufacturers of building materials appointed an organizing committee which met in Chicago September 27 to create the National Congress of Building and Construction Interests, and appointed a Congress Executive Committee which met in Pittsburgh, October 29, and reorganized itself into an executive board composed of five general contractors, five sub-contractors, five architects, five engineers, five manufacturers and distributors of materials and equipment, and five representatives of labor and investment capital. The purpose of the executive board is not to create a national organization, but to form a deliberative body with mandatory power.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



ONE MAN MOTOR CAR WITH HEATING AND ELECTRIC LIGHT SYSTEMS

FOUR-WHEEL DRIVE MOTOR CARS

Passenger motor cars operating on standard gauge railroad tracks have been perfected by the Four-Wheel Drive Auto Company, which recommends them for short-line runs, to save high operating cost that can be overcome by this vehicle, although they practically exclude ordinary steam or electric freight or passenger locomotive business. It is estimated that there are more than 600 short-line railroads in this country on which a considerable saving could be effected by the use of railroad motor cars instead of locomotives.

The New Orleans and Lower Coast Railway has installed a railway locomotive truck to replace a passenger train on a 60-mile run from Algiers to Duras, La. The regular motor and standard truck chassis, modified only by the substitution of steel flanged wheels, is used with a car body built in the railway company's workshops and providing seats for thirty-two persons. The entrance is from folding doors on the sides and the car, equipped with M. C. B. coupler, can be used for switching or hauling a trailer.

The starting and lighting system is furnished by a 24-volt single unit equipment and the exhaust gases from the motor are used to heat the car through radiator pipes on the sides.

As this motor truck car can be handled by one man and effects considerable economy in depreciation, fuel, breakage and replacement, its service saves approximately 25 per cent of the ordinary railroad service. The normal speed is 25 miles an hour, with 7½ to 9 miles per gallon of gasoline.

Another example of the application of the four-wheel drive principle to railroad transportation is afforded by a truck which has been successfully operated for nearly a year on a 16-mile run from Palatine to Lake Zurich, Ill.

A NEW ALL-MULTIPEDAL AUSTIN TRENCHING MACHINE

A new type of trenching machine now being placed on the market is designed to turn within its own length, and is absolutely a "one man" machine.

A screw hoist automatically raises and lowers the digging arm that carries an endless chain of standard type buckets. This screw hoist also acts to force the bucket line against the face of the ditch.

A cleaning device takes care of the sticky dirt and scrapes out each bucket as it passes a point at the head of the excavator boom directly over the conveyor belt, which can be adjusted to deliver the excavated material to either side of the machine.

The gasoline engine is of 4-cylinder, 4-cycle type, cooled by an enclosed radiator.

The digging width, with 18-inch buckets, will run from 20 inches to 28½ inches, and with 24-inch buckets from 26½ inches to 29 inches. The standard boom will dig up to 6 feet in depth, and the machine can be modified to dig 8 feet deep. Each of the two oscillating multipedal tractions is driven independently of the other by a friction clutch, so that in turning in a confined space, one may be stopped while the other is going ahead, turning the machine within its own length.

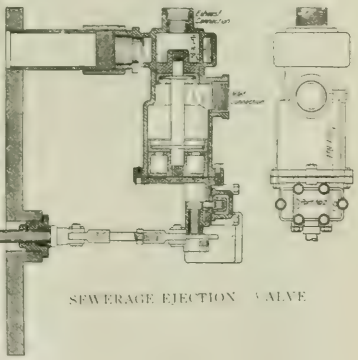
It is light enough to handle efficiently trenches for house connections, sewers, etc., and will cross sidewalks, climb over curbs, cross bridges, and travel over any and all types of pavements, thereby reducing to a minimum the danger of damage claims. Its road traction speed is higher than that of ordinary trenching machines.

An important feature is its easy interchangeability for digging trenches with vertical banks or small ditches with sloping sides.

COX OPERATING VALVE ILLUSTRATED

After a long series of tests the Pacific Flush-Tank Company offers the new Cox operating valve for sewage ejectors, for which it is recommended on account of the simplicity of construction, ease of maintenance, advantage of open float, and the small number of wearing parts, which consist of two standard cup leathers which can easily be purchased and replaced.

The admission of sewage to the ejector raises the float, which operates the lift-rod connected to the slide valve by a lever which turns it and uncovers the opening of port No. 2, thus allowing compressed air to pass from port No. 1 through port No. 2 to the back of the piston, equalizing the pressure and permitting the piston to travel toward the exhaust opening, where pressure admitted through port No. 3 forces out the sewage.



SEWERAGE EJECTION VALVE

After the sewage has been ejected, the bucket weight pulls down the operating lever and closes port No. 2, causing the piston to travel back to its original position closing port No. 3 to pressure and opening them to exhaust, ready for another cycle.

UNION FITTS CHRONMETER VALVE

These valves manufactured by the Union Water Meter Company are recommended as standard where it is required to provide quickness and ease of operation and sensitive adjustment to varying conditions for the control and regulation of the flow of the steam, water, gas, oil and air to engines, stokers, tanks, blowers, etc.

They are easily adapted to service conditions and may be set vertical, horizontal or oblique without expensive special fitting. They are of the rotating type with a conical valve ground to a joint with ports completely opened or closed by a one-eighth turn.

HIGHWAY TRANSPORTATION NOTES

New York City's first Highway Transportation Show started on Monday, January 3, and continued right through until January 8, with something of interest every minute of the time. Because no one building large enough for all the exhibits could be secured in the city, the Motor Truck Association, under whose auspices the show was held, secured the Twelfth Regiment Armory and the First Field Artillery Armory. There is no distinction between the exhibits at the two armories, except that trucks exhibited at one armory were not duplicated in the other. The exhibit included twenty-six makes of motor trucks, three makes of trailers and a great array of parts and accessories.

Monday, January 3, was "Opening Day"; Tuesday, "Army Day"; Wednesday, "Motor Accident Prevention Day"; Thursday, "Transportation Day"; Friday, "Farmers' Day"; Saturday, "Motor Truck Association Day."

Special features of the show included a truck drivers' contest for a prize of $500, awarded to the driver best explaining in not more than 250 words the ten best points of any truck chassis exhibited in either of the two armories; and a special moving picture exhibition showing all means of both ancient and modern transportation by rail, waterway and highway, secured through the courtesy of Dr. Francis J. Halley of the U. S. Bureau of Economics. One of the most unusual films in this collection was that showing 90,000 camels snapped through a telescopic lens in the Algerian desert by the French government. All these films were run continuously.

The headliner among the motion picture films was an animated Bray cartoon reel on the Elements of the Motor Truck Engine.

On Army Day the most complete equipment ever gathered together for any other than military purposes, was exhibited, including several million candlepower dishpan searchlights which were stationed outside of each armory; a portable machine shop truck in operation; a rolling kitchen; an anti-aircraft gun; signal corps equipment and films of actual battle scenes; a wireless telephone and several makes of standardized army motor trucks. One special feature was a contest between two teams of army motor mechanics in disassembling and reassembling a Class B standardized truck engine against time for a cash prize.

Dr. John A. Harriss, Deputy Police Commissioner in charge of traffic, New York City, and inventor of the modified block system of traffic control on Fifth avenue, gave a talk on preventing motor vehicle accidents.

Other speakers were Ex-Governor Smith, who had just joined the U. S. Trucking Corporation; E. S. Farr, chief of the Firestone Ship-by-Truck Bureaus, who gave a talk and exhibited his unusual film entitled "The Neck of the Bottle,"; and James W. Brooks, director of the Federal Highway Council, who spoke on the necessity for adequate truck highways and exhibited his film, "Trucking through Dixie."

INDUSTRIAL NOTES

ERRATUM

In the review of the High Efficiency Pumping Machinery Catalog of the Blake Pump and Condensor Co. that was published on page 19, January 1, substitute electric for "steam," in the fourth line of the article. The efficient application of a motor drive instead of steam is an important feature of the improved equipment.

DECEMBER LUMBER PRODUCTION FAR BELOW NORMAL

The Southern Pine Association reports that for the week ending December 31 out of 89 sawmills 58 were shut down and only 4 operated on full time, the remainder being run from one to five days each during the week and together with 36 other mills, which did not specify the amount of time run producing a total of only 689,206 feet during the week, and amount which is 73.86 per cent below normal.

AUSTIN MACHINERY CORP. ACQUIRES FAIRMONT PLANT

The large plant of the Fairmont Machine Company, of Fairmont, W. Va., has become the property of the Austin Machinery Corporation, of Chicago and New York, manufacturers of earth-working, concrete-mixing and material-handling machinery, and will continue to make its own line of machinery besides contributing to the manufacture and distribution of earth-handling and cement-mixing machinery.

AMERICAN ROAD BUILDING ASSOCIATION

At the exhibition of road materials and equipment to be held at the Coliseum, Chicago, February 9, 10, 11 and 12, more than one-half million dollars' worth of machinery will be on display, the Austin Machinery Corporation alone supplying more than seventy-two tons. Excellent entertainment will be provided. The city of Chicago has appropriated $15,000 for this purpose. Cuba and Hawaii will be represented by special delegations.

WHAT IS YOUR HIGHWAY PROBLEM?

A free portfolio entitled, "What Is Your Highway Problem?" has just been issued by the asphalt sales department of the Texas Company. It describes the steps in the construction of the various types of asphaltic pavements and roads. Each type of construction is illustrated with photographs and some are supplemented by drawings.

The types of asphaltic construction discussed are sheet asphalt, asphaltic concrete, asphalt macadam, asphalt for surface treatment, asphaltic road oils, asphalt filler, asphalt foundation, the use of asphalt to resurface worn brick and to resurface cement concrete. The portfolio begins with a description of Texaco highway service and ends with a list of Texaco products and their various uses.

The Philadelphia Electric Co., Philadelphia, Pa., will build a new conveyor system for coal and ash handling at its plant at Beach and Palmer streets. The contract for this work, which will cost approximately $75,000, has been let to Stone & Webster, New York.

PERSONALS

Popham, Owen, formerly city councilman, has been appointed chief engineer of the water works of Coshocton, Ohio.

Barber, William C., mayor of Joliet, Ill., has accepted the position of city manager of Dayton, Ohio.

Clark, Edward S., who has been in the employ of the city of Kalamazoo, Mich., for more than thirteen years, has been appointed city engineer.

Hendry, W. A., has been appointed chief water works engineer of Waterloo, Iowa.

Storm, John, has been appointed engineer of the water works plant of the Public Service Co. at Mattoon, Ill.

Hiet, Melvin E., is now engineer of Nowata county, Okla., and is also engineer for Pawnee county.

Huber, J. E., district engineer of the Illinois Department of Public Works and Buildings, Division of Highways, has resigned to accept a position with the Western Wheeled Scraper Co., Aurora, Ill.

Cadle, Charles L., chief engineer of the Rochester Lines of the New York State Rys., has been appointed by Governor Miller as superintendent of Public Works.

Golden, Louis V., Barnes, Loewis E., and Whitwham, William, members of the board of water commissioners of Methuen, Mass., have tendered their resignations to Mayor Rushton, charging lack of co-operation on the part of the city council.

Bamford, William R., M. Am. Soc. C. E., was recently elected mayor of Belmar, N. J. He is planning the adoption of the borough manager type of government, which will be the first of its kind in New Jersey.

Cloney, Thomas, has been appointed city manager of Vicksburg, Mich.

Brett, J. L., who since 1919 has been assistant engineer of the water works of Montreal, has been appointed design engineer of the Montreal water board.

Shields, Francis S., has resigned as secretary of the sewer and water board of New Orleans, and will be succeeded by A. G. Moffatt, who has been assistant secretary since 1903.

Davis, S. B., has resigned as county engineer of Wood county, Texas.

Arnold, E. M., has resigned as county engineer of Boone county, Ky., and is now assistant engineer with the Georgia State Highway Department.

Peabody, L. H., civil engineer in the bridge department of the Rhode Island State Department of Public Roads, died on November 16, at the age of 42 years.

Wood, W. T. S., president of the board of county commissioners of Gibson county, Indiana, died on November 20.

Kyle, H. L. I., formerly roadmaster at Sacramento, has been appointed engineer of the Western Division, Western Pacific.

Moore, Thomas J., city manager of Guelph, Ont., since 1908, was killed recently in Northern Ontario while on a shooting trip.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1926, under the Act of March 3, 1879

Vol. 50 FLORAL PARK, JANUARY 29, 1921 No. 5

Sewer Construction in Kokomo, Ind.

Manufacture and installation of about 58,000 feet of reinforced concrete pipe up to 84 inches diameter. Fifteen 4-foot lengths of 84-inch pipe weighing about 10,000 pounds each laid in six hours.

About one-half of the six square mile area of Kokomo, Ind., will be drained by three sewers, the contracts for which have been let, and one of which is now under construction. The contract for the Conkle sewer, the maximum diameter of which is 39 inches, has been awarded to Peter Frandzen, Kenosha, Wis., but construction on it has not yet been commenced. Contracts for the $185,000 Beal sewer of 72 inches maximum diameter and for the Washington street relief sewer of 84 inches maximum diameter have been awarded to Edward Conricote, Youngstown, O., for $185,000 and $315,000, respectively, and work was commenced last October on the construction of the Washington street sewer, on which there had been installed up to December 17, 1,000 linear feet of the 84-inch pipe.

The specifications for the sewers covered segmental block, reinforced concrete pipe, and monolithic construction, offered as alternatives, all of circular cross-section. The contracts were awarded for bids specifying concrete pipe as manufactured by the Independent Concrete Pipe Co., Indianapolis. The work is being done under the authorization and supervision of President Danner, consulting engineer Davenport, of the Board of Public Works, the portions of it extending to the outlets beyond the city limits being in charge of County Surveyor Ellsworth Hunt.

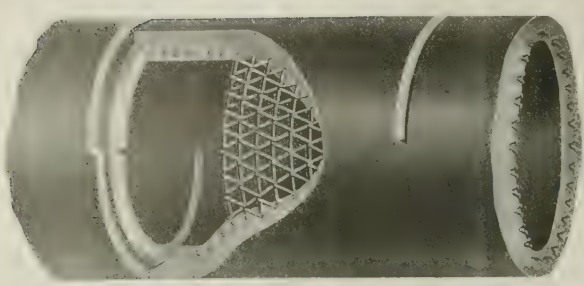
The Conkle sewer comprises 5,980 feet of sewer 8 inches in diameter and 1,068 feet of sewer 39 inches in diameter, together with lengths of 132 to 2,891 feet of most of the various sizes intermediate between these limits. The Beal sewer consists of 9,243 feet of 8-inch sewer, 1,084 feet of 72-inch sewer, and from 147 to 4,493 feet of 15-inch, 18-inch, 24-inch, 27-inch, 33-inch, 36-inch, 48-inch and 84-inch sewer. The smallest diameter of the Washington street sewer is 18 inches, of which there is 1,228 feet and from 237 to 3,584 feet each of most of the intermediate sizes up to 84 inches in diameter. The combined lengths of all the different sizes of the three sewers is 57,995 linear feet.

CASTING 8,300 FEET OF 72 INCH CONCRETE PIPE

DETAILS OF PIPE AND JOINTS

The make of pipe adopted has a slightly tapered hub and spigot joint, made entirely within the thickness of the walls, which varies from about 2½ inches for 24-inch pipes, to 8 inches for 84-inch pipe. The joints are so constructed that below the spring line they are filled with mortar applied from the interior and above the spring line are filled with mortar applied from the exterior of the pipe.

Pipes 42 inches and less in diameter are reinforced with one ring each of American Steel & Wire Co.'s triangle mesh fabric having a cross-sectional area per foot of from 0.068 to 0.153 square inches. For larger pipes up to and including 84 inches in diameter, the reinforcement consists of two rings of the same fabric, the cross-



REINFORCED CONCRETE PIPE WITH SPECIAL JOINT

sectional areas varying from 0.107 to 0.208 square inches.

The 1:2:4 concrete used in the pipes is made with Portland cement, clean, well-graded sand containing not more than 5 per cent of loam, and free from all alkali or organic matter, and clean, crushed stone having a specific gravity of not less than 2.5 and, for all except the 78-inch and 84-inch diameters, of a size to pass through a ¾-inch ring.

MANUFACTURING THE PIPE

The manufacture of the pipe for the three contracts will require about 2,800 yards of sand, 5,500 yards of broken stone or gravel and 9,200 barrels of cement. On the Washington street job the pipe is made in the street where it is to be laid, by a mixer plant moving along the line sufficiently in advance of the trenching and installation operations to permit the pipe to be properly seasoned before it is handled.

Cement, which is delivered daily to the mixer, is of the Universal brand and the Hoosier brand, the latter made by the Indiana Portland Cement Co. at their Greencastle plant, which has been only about a year in operation. The sand and gravel are furnished by the Baker Gravel Co., Noblesville, Ind., and by the Richmond, Ind. plant and the Greenville Gravel Co.

Broken stone, delivered on trucks by the Kokomo Stone Co., is a local product, satisfactorily tested for quality at the Lewis Institute, Chicago. The size, however, is so uniform that there is rather a high percentage of voids, which has been overcome by making the aggregate half stone and half gravel.

The mixing is performed so carefully that an average day's run, requiring 470 sacks of cement, will not vary more than 1 to 6 sacks from the theoretical amount. The concrete is mixed in a Wonder machine manufactured by the Waterloo Construction Machinery Co. The mixer, truck and all, is erected on an elevated platform built on another truck with which the plant is moved ahead as required. The mixer is equipped with power elevating charging hopper, erected on an extension track long enough to permit it to be lowered to the ground and filled by wheelbarrows and then hoisted to such a height that the mixed concrete can be spouted directly into the pipe forms, which are 4 feet high. Special care is taken to avoid an excess of mixing water, and only enough is used to make a workable mix of very light consistency, which is constantly watched while the mixer is in operation so that the product is very uniform.

The cylindrical steel sheet forms 4 feet high are reinforced with vertical angles and circumferential tees and are provided with top and bottom cast iron rings. They are assembled in rows on the street and the concrete machine moves along the line filling one after another as it advances. The reinforcement fabric, overlapping 8 inches at joints, is spaced 1¼ inches from both inside and outside walls, and is held in accurate position in the forms by wooden spacers that are removed as the concrete is placed around them.

The mixer delivers the concrete directly to a platform on top of the pipe form, from which it is scraped by hand into the annular space between the outer and inner cylinders, in which it is thoroughly spaded to release any confined air and secure maximum density.

For three days the pipes are kept moist by frequent wettings with a hose, and after they are sufficiently set are tipped over into horizontal position and rolled into the gutter, where they remain with minimum obstruction to traffic until they are laid in the trench.

The plant has a capacity for 32 feet of 84-inch pipe, 100 feet of 39-inch pipe and 54 feet of 72-inch pipe daily, stripping the pipes about 24 hours after they are cast. They are generally from 10 to 15 days old when installed in the trench, but sometimes are 30 to 40 days.

TRENCHING

Washington street carries the heaviest traffic in the city on a brick pavement 36 feet wide between curbs. The sewer trench on the center line

BOTTOM RINGS SET TO RECEIVE STEEL PIPE FORMS

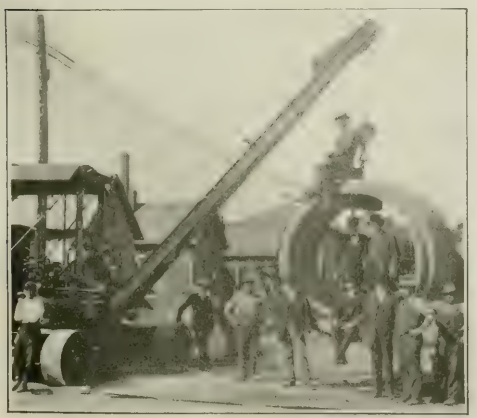
of the street has a maximum depth of about 20 feet and a width of about 11 feet. Although the soil encountered is a stiff, blue clay that can easily be cut and handled and that will stand up without sheeting, considerable difficulty has been encountered on account of the presence, 4 feet each side of the trench, of large water mains and of a large number of service pipes. The excavation is made to a depth of about 16 feet by a model 4 Keystone steam shovel, while a ¾-yard Lakewood clam-shell excavating bucket operated by a Little Giant 4-ton road crane manufactured by the Locomotive Crane Co. of Champlain, Ill., completes the excavation below the 16-foot level. All the spoil not required for backfill is delivered directly to dump wagons, which haul it a short distance to spoil banks along Deer creek, where it is used as fill for making city park improvements.

PIPE LAYING.

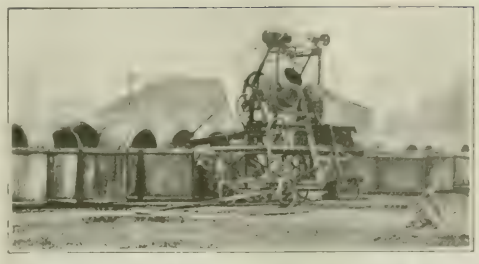
The weight of the pipes per linear foot is approximately 580 pounds for the 39-inch, 1,750 for the 72-inch and 2,340 pounds for the 84-inch sizes, making sections weigh up to about 10,000 pounds. The sections are rolled by hand from the curb to the trench, and lowered to position by the road crane equipped with a special hook or goose neck (shown in the illustrations), which is made either of cast steel or of I-beams bolted together.

The pipe is lowered in the trench and the end is inserted in the end of the pipe already assembled, after which it is carefully aligned and adjusted on the trench bottom and the joints are rapidly made by a workman with a bucket of mortar and a trowel, who first seals the invert half from the inside and then completes the work by filling the upper half from the exterior.

During the early part of December the 84-inch pipe was laid at the rate of 20 to 30 linear feet per day, but on one occasion 60 feet of 84-inch pipe was laid in 6 hours and it is believed that 90 feet of the same size could be laid in one day if the trench was prepared to receive it. An important feature of the work is that the trench is backfilled immediately after each joint is sealed, the backfilling being maintained so close to the end of the pipe that there is ordinarily not more than 20 to 25 feet of trench left open at any one time, thus minimizing the obstruction to traffic.



HANDLING PIPE SECTIONS WITH GOOSE NECK LIFT



FILLING PIPE FORMS FROM MIXER MOUNTED ON MOVABLE ELEVATED PLATFORM

Development of the Port of New York

At a meeting, December 15, of the New York Chapter of the American Society of Civil Engineers, a paper on "The Port of New York—The Problem," was represented by B. M. Cresson, Jr., consulting engineer of the New York-New Jersey Port and Harbor Development Commission, which is investigating the problem of improving harbor facilities.

He discussed the lack of central administration of this total plant for the principal elements of commerce, railroad and steamship traffic of the country where more than $150,000,000 have already been expended in building docks, piers and harbor facilities. These have no continuity of administration and no co-ordination of plans for the interests that are divided by the imaginary lines between the states of New York and New Jersey, which condition is aggravated by the fact that in the latter state the jurisdiction of the water front is divided between perhaps 40 separate localities. These and other conditions make New York a port of individual endeavor, so far without any general comprehensive plan of development. This applies not only to the railroads with their multiplication of separate costly facilities, but to the steamship terminals and to the lighterage and trucking facilities and even to the warehouses.

There has now been appointed by New York and New Jersey an interstate commission to study the port problem as a whole without respect of the political boundary line. This work is difficult and elaborate and will require a great deal of investigation and analysis which will include the consideration of barge canal terminals for the port, canals and waterways, private terminals, stevedoring operations, tariffs, charges and rates, ferries, handling of fuel, handling of grain, handling of building materials, channels and dredging, banking and commercial operations, electric power supply and other features.

The joint commission has recommended the

legislative enactment of a treaty binding together all parts of the Port District to be administered by a port authority. Under it the municipalities will be adequately protected in the investments that they have made and in the facilities that they have created. There is to be no pledging of public credit for the development of future facilities but merely the creation of a central body with sufficient authority and power to encourage private or public initiative to construct modern terminals as part of an organic whole. It will form a medium under which funds can be raised without respect to the debt limit or the borrowing capacity of any of the component parts of the port district.

New York's problem is not local. It passes under normal conditions half of the foreign commerce of the United States.

There is danger that unless the component parts of the port cease wrangling among themselves and get down to consideration of the development of the port as a business entity, that the Federal government may step in and the control of the port be changed from local to national. It seems likely that such a situation, which would surely be affected by political changes and by the jealousies of other ports and sections of the country, would not solve the problem so well as if the control and administration of the port were retained within the Port District where there is local knowledge and local pride, and under which it is probable that the best results could be achieved not only for the port itself but for the entire nation.

Changes in New York's Building Zones

By Edward M. Bassett*

The Greater New York building zone law has been in operation since July 25, 1916—about four and one-half years. The protective requirements are shown on three maps, known as height, area (or bulk), and use maps. The charter provides that changes in the maps can be made by the Board of Estimate. The aggregate changes are extremely small in area, showing the remarkable permanence of the protection of the zoning system. All the changes made since its adoption affect only about 1⅓ per cent of the total city area zoned. On account of war conditions and decrease of construction the use map changes are the greatest. These are 1/99th of the whole area. Area map changes are 1/335th and height map changes are 1/1000th of the whole area.

In the years 1916-1919, inclusive, ninety-three applications for changes were granted by the Board of Estimate and seventy-two were denied. In 1920, twenty-seven were granted and about the same (the precise number not yet ascertainable) were denied. These figures tend to show that changes are not easily obtained. This is as it should be, because when an owner builds according to the zoning requirements he ought to be protected against easy changes of surrounding requirements.

The total map changes since the beginning (1916-1920, both inclusive) have been one hundred and twenty. There were four in 1916, forty-three in 1917, twenty-six in 1918, twenty in 1919 and twenty-seven in 1920. The small number for 1916 was due to the law being in operation only five months and the possibilities of change not being widely understood. In 1917 the peak of changes was reached, and in succeeding years only about one-half as many changes were made each year. It would appear from this that during the last three years the map changes were fairly proportioned to the normal growth and change of the city.

Use map changes were one hundred and seven, area map ten, and height map three. It is quite possible that as the amount of new construction increases, more changes proportionally will be made in the area and height maps.

In 1916 the four changes all relaxed the restrictions; in 1917, thirty-six relaxed and seven strengthened the restrictions; in 1918, twenty relaxed and six strengthened; in 1919, thirteen relaxed and seven strengthened; in 1920, twelve relaxed and fifteen strengthened. In other words, in 1916 there was no strengthening, in 1917 the strengthening as compared to relaxation rose to 19 per cent, in 1918 to 30 per cent, in 1919 to 54 per cent and in 1920 to 125 per cent, when for the first time the strengthening changes exceeded the relaxing changes. These figures showing relaxation and strengthening are most gratifying. They show not only official support of the zoning system, but they show clearly that property owners are gradually favoring the strengthening of the zoning requirements rather than their relaxation.

The building zone system of New York may be deemed a success. Other cities, which have recently adopted it or are preparing their maps, may well be encouraged by the experience of New York.

*Counsel, New York City Zoning Committee.

A Traveling Gravel Plant

A product of about 300 yards of gravel and sand per 9-hour day is secured from a simple traveling plant installed in a gravel pit by W. C. McLeod, Livingston, Mont. A 14-D Bucyrus revolving steam shovel with caterpillar traction moves along the base of the gravel and sand banks on 6-inch blocking that raises it high enough to deliver 18 feet above the ground to a grizzly over the top of a movable storage hopper from which the gravel is delivered to trucks underneath while the oversize rejects from the grizzly are spouted to waste or into wagons alongside.

The storage bin is mounted on skids and is attached by a chain to the steam shovel which hauls it along as it advances. The steam shovel consumes about 2,000 pounds of coal per day and furnishes sand for use in the construction of concrete pavements for the city of Livingston.

Flexible Pavement Bases

Advantages of such bases as indicated by experience and by tests on large slabs and beams explained by Prevost Hubbard. Asphalt concrete base shown to have high slab and beam strength.

In a paper read last December before the Engineers' Club of Philadelphia, Prevost Hubbard, chemical engineer for the Asphalt Association, gave particular prominence to the applicability of flexible types of construction for pavement base as compared with the more rigid type of which the cement concrete base is the most common illustration.

Almost any well-compacted soil will of itself support the heaviest conceivable traffic if its moisture content is so controlled as to make its supporting power a maximum and if the pressure is transmitted by a structure which prevents the displacement of particles at the surface. Some soils are so affected by moisture and so retentive of moisture that reaches them that, if it is impossible to exclude moisture from them when serving as pavement sub-grade, it is desirable to modify the character of the material by adding to it sand or other materials. "It is evident that in many cases it will cost far more to increase the thickness of a pavement to such an extent that it will distribute the load sufficiently to enable a poor sub-grade to support it, than it would be to change natural sub-grade conditions so as to create a high supporting value for the relatively thin pavement."

Rigid foundations are claimed to have a bridging value, although "as a matter of fact no practicable design of highway for modern heavy traffic permits the assumption of more than a temporary bridging action over appreciable areas of a weak sub-grade."

Most engineers, especially in the east, continue to employ rigid foundations on this theory of bridging action, although considerably over 12 million square yards of flexible type of construction as represented by asphalt base pavement are now giving satisfactory service in California and Oregon, many of them five inches or less in total thickness and subjected to heavy motor truck traffic. Some of these pavements have been in service for over 20 years with little or no cost for maintenance. In addition, there are in Washington, D. C., Chicago, Omaha, Pittsburgh, Buffalo and Denver sections of bituminous base which have given satisfactory service for over 20 years, these showing that serviceability of this type is not restricted to any one locality.

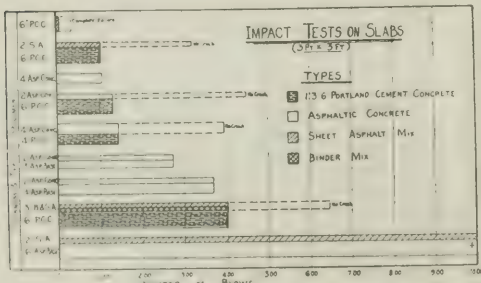
Before following the precedent set by these examples, it is, of course, necessary to understand the engineering principles of their operation and service. "Some degree of cushioning effect under traffic has been claimed and admitted for the asphalt base as well as for the wearing course, but few engineers have believed that a mineral aggregate cemented together with asphalt could possibly possess any degree of slab strength or beam strength, at least to an extent comparable with the rigid type of construction." In order to demonstrate this and to obtain some definite figures for comparison, an investigation has been begun under the direction of Mr. Hubbard, assisted by W. E. Rosengarten, traffic engineer of the Asphalt Association. The experiments of the Bureau of Public Roads (previously referred to in PUBLIC WORKS) have already shown that impact rather than dead load is the destructive factor on the highways and "it was therefore decided to limit these investigations to a study of the effect of impact upon test specimens having thicknesses equivalent to those commonly used in the construction of highways. It was clearly realized in advance that it would be impossible to duplicate all of the variable conditions under which impact is delivered to a pavement by traffic and it was therefore decided to confine this study to the effect of pure impact as delivered by an iron ball falling from a relatively small height. The results here reported are only a portion of those included in a more comprehensive investigation involving other comparisons which will shortly be presented in a detailed article.

"In order to obtain comparisons at two extremes of conditions, it was decided to construct and test slabs of various design upon a solid uniform sub-grade and to test beams of the same design supported only by knife edges. A plot of ground was secured and upon this was laid a six-inch course of cinders thoroughly compacted by rolling. Slabs three feet square were constructed directly upon this sub-grade except that, after the forms had been placed, the sub-grade within the forms was leveled up with a very thin layer of sand so that each specimen would have a uniform thickness throughout. Portland cement concrete slabs were cast four and six inches thick of a 1:3:6 mix. These were cured under a cover of moist sand after they had set. Some of the concrete slabs were then covered with from two to four inches of coarse graded aggregate asphaltic concrete and some with sheet asphalt with and without a binder course. In addition, slabs were constructed of asphaltic concrete base mixture

and covered with either asphaltic concrete surface mixture or with sheet asphalt so as to produce total thicknesses directly comparable with the Portland cement concrete base specimens. At the same time, corresponding sets of beams four feet long and ten inches wide were constructed of the same type and thickness. In general the specimens were tested when the concrete was 28 days old, although in a few cases they were slightly older when, for one reason or another, it was found impossible to keep up with the testing schedule which had been planned.

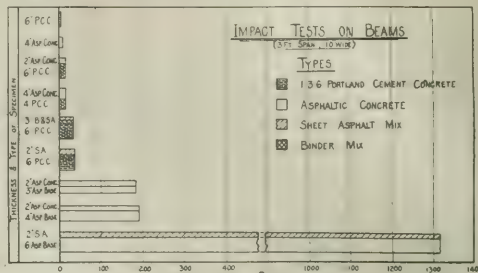
All slabs were tested where they had been cast by means of a machine which was designed and operated so as to drop a 125-pound iron ball upon the center of the upper surface from a height of six inches at the rate of about 30 blows per minute. In all cases a specimen was considered to have failed when the first crack appeared. Cracks in the Portland cement concrete were invariably first noted developing on one or more sides of the specimen from the plane of contact with the subgrade. Under continued impact these cracks traveled to the upper surface of the monolith and then across the upper surface toward the center. The all-Portland cement concrete specimens broke into two to four large fragments shortly after the first crack appeared, while similar slabs with an asphalt top showed no cracking of the top after the base had failed. The results obtained on check specimens were in some cases erratic, in others quite close together. By averaging results, however, the general trend is apparent and is closely borne out by results obtained on the beam specimens.

The following diagram shows the resistance to impact of the various types of slabs as measured by the number of blows required to produce failures. The dotted extensions of the asphalt tops on slabs with a Portland cement concrete base show the number of blows at which the test was stopped, no failure of the top then being apparent.



RESULTS OF IMPACT TESTS ON SLABS

The beams were tested upon steel knife edges three feet apart with the same machine used for testing the slabs but with a 50-pound iron ball dropped from a height of 12 inches at the center of the span at the rate of about 50 blows per minute. The number of blows required to produce the first crack was recorded as point of failure. In all beam tests complete failure occurred within a very few blows after a crack appeared. The results of these tests are shown in the second diagram in the same manner as the slab tests.



RESULTS OF IMPACT TESTS ON BEAMS

In considering these diagrams no attempt will be made to draw conclusions based upon a comparison of absolute values as here shown. In fact, it is frankly admitted that such a course would be unwise until many more test data are available. It is believed, however, that the general similarity in trend of the results obtained in both the slab and beam tests is highly significant and points to interesting facts. What is clearly apparent for conditions under which these specimens were tested may be summed up as follows:

Asphaltic mixtures develop very decided slab and beam strength as measured by their resistance to impact. The all-asphalt type of slab and beam appears to offer considerably more resistance to impact than an equivalent thickness of 1:3:6 Portland cement concrete considered either as an integral structure or as a base for an asphaltic top.

It is recognized that, unsupported by practical service results, deductions drawn from these tests might not be conclusive as applied to the design of highways for heavy traffic. They do, however, help to explain the remarkably satisfactory service record of the millions of square yards of 4 and 5-inch asphaltic concrete pavements in California and Oregon and point the way to a more rational development in the design of highways in other localities.

In summing up the substance of this paper, there are a few points which the writer wishes to emphasize:

1. Any rational design of highway should take into account the fact that the sub-grade must ultimately take the weight and shock of traffic as transmitted through the pavement, and practically any reasonably dry sub-grade will do this if it is compacted and its surface is protected from displacement. Careful attention to sub-grade preparation and drainage is therefore the first essential to be considered.

2. The asphaltic concrete pavement is highly resistant to impact, which is recognized as the most destructive traffic factor, and under impact develops as a single unit relatively high slab and beam strength.

3. It is manifestly uneconomical if not imprac-

ticable to adopt a design of highway that will permanently bridge appreciable areas of weak sub-grade. While the asphalt type develops bridging action to an appreciable extent, it will of itself constantly seek to maintain contact with the sub-grade at all points and thus reinforce itself with the maximum supporting value of the sub-grade. The rigid type of pavement or base cannot do this because of its inherent characteristics. It is therefore almost sure to crack eventually where appreciable areas of sub-grade fail to support it uniformly.

4. Both the service history of asphalt-base pavements and the test data here presented indicate that under given conditions it is not necessary to adopt so massive a design for the flexible type of base as for the rigid type. It is difficult for engineers who have had no opportunity to observe the asphalt-base pavement under heavy traffic to think of it in terms of less thickness than the rigid base, but in the light of present experience such consideration appears to be entirely warranted.

City Planning For Kansas City

Kansas City, Mo., has a planning commission, and this commission has chosen a professional city planner to advise it. Kansas City, Kan., also has a city planning commission, and this commission also has chosen a city planner. There is little besides political boundaries to separate the one Kansas City from the other, and from every practical point of view it is desirable that the planning of the two cities should be carried on as a single problem. It is therefore fortunate that the planning commissions of both cities should have chosen the same city planner, George E. Kessler. It seems probable that Mr. Kessler will be given authority to consider as one problem the planning not only of the two cities, but also of the area within a five-mile radius of the greater city. With the growth of the cities their inter-relation and inter-dependence will necessarily become closer. Street alignment and grades, bridges, street car traffic and possibly park systems and other features can be designed to much greater advantage if they are not limited in either case by the political boundaries of the cities, but may be developed without regard for such boundaries.

New York City's Preparations For Snow Removal

One thousand men of the Police, Fire and Street Cleaning Departments of New York City are now being trained to handle the 50 caterpillar tractors recently purchased to keep the streets clear of snow the coming winter. They are instructed in driving, lubrication and maintenance, with the idea of providing plenty of competent operators, no matter what emergency comes up.

The tractors will be stationed in fire engine houses, located at strategic points about the city, so that at the first snow fall, during the day or night, they can be promptly put to work.

The schools of instruction have been established under the supervision of Mr. E. H. Bate, service engineer of the Holt Manufacturing Company. During the past month some 400 men have learned to drive and 700 of them have received instruction in lubrication. Owing to the ease of driving a caterpillar and keeping it in good working condition when the instruction work is completed, New York City's snow removal equipment and operating personnel will probably be second to none in the world.

Pavement Specifications of the A. S. M. I.

Changes under consideration by the American Society for Municipal Improvements in that society's specifications for concrete, stone block, sheet asphalt and brick pavements.

CONCRETE SPECIFICATIONS

The Committee on Specifications of the American Society for Municipal Improvements has submitted to the members a set of specifications for Portland cement concrete pavements which it recommends for adoption in place of those previously adopted by the society. Some of the features of these specifications are as follows:

Proportions of cement and fine aggregate and coarse aggregate to be in the ratio of one part cement to not more than 6 parts of other aggregate, the exact proportion to be determined by screen analysis with a view to obtaining a uniform density. In no case shall volume of fine aggregate be less than ½ the volume of course aggregate, nor the volume of cement less than ⅛ that of the aggregate, and a cubic yard of concrete in place shall contain not less than 6 bags of cement.

Steel forms shall be used, well staked [illegible] to the established lines or grades.

Concrete pavements 20 feet or under in width should be reinforced throughout with a steel fabric having an effective weight of not less than 30 pounds per 100 square feet, members to be at right angles. Reinforcement to be laid with the main members across the pavement. The ratio of effective area across the pavement shall approximate 1 to 1 along the axis of the pavement. The spacing of the main members of the fabric shall not be more than 6 inches nor less than 4 inches. Tie members to be not more than 12 inches nor less than 8 inches.

Concrete pavements wider than 20 feet should be rein-

forced with a steel fabric having an effective weight of not less than 30 pounds per 100 square feet, which shall be increased in weight one pound for each foot of width of pavement up to 50 feet.

Reinforcement shall be placed at right angles to the axis and generally 2 inches below the surface of the pavement. The fabric shall extend to within two inches of the ends and sides of the slabs.

For finishing the concrete, it is provided that it shall be brought to correct surface by means of a screed used with a tamping movement, to be followed by the use of a metal roller, weighing approximately 15 pounds per linear foot of width, worked across the roadway, the surface to be finished by drawing a rubber garden hose or a rubber belt along the surface while still wet. (Apparently a mechanical finisher may be used as an alternative to this method, since the specifications state that: "Should a mechanical finisher be used, care must be taken to keep the mixture sufficiently dry.")

The pavement may be cured by covering with two inches of earth, straw, marsh grass, hay, etc., to be kept wet for at least ten days. Under the most favorable conditions for hardening, traffic shall be kept off the pavement for at least 14 days, and longer in cool weather.

Concrete is not to be mixed or deposited when the temperature is below freezing, and if it should drop to 35 degrees or indications are that it will drop this low within 24 hours, the aggregate shall be heated and precautions taken to protect the work from freezing for at least ten days.

STONE BLOCK SPECIFICATIONS

Modifications in the stone block specifications of the A. S. M. I. include, as an addition, provisions for laying Durax paving blocks, as follows:

Durax paving blocks shall be cut from granite complying with the requirements specified herein for new granite paving blocks. The blocks shall be cubes of granite with six approximately square surfaces, the edges of which measure not more than 4 nor less than 3 inches in length. They shall be dressed so as to conform with the requirements specified for new granite blocks except as to form and dimensions. They shall be laid as specified for new granite blocks except that the courses shall be laid in circular concentric arcs with the largest blocks at the center of the arc and the smaller ones at the springing line. The radii of the arcs may be varied from 3 to 7 feet.

Provision is also made in these specifications for a tar and asphalt filler which is described as follows:

The mixture of coal tar pitch and refined asphalt shall be composed of 100 parts of coal tar pitch and 20 parts of refined asphalt. The tar and the asphalt shall each comply with the requirements herein specified in sections 13 and 14, except that the penetration of the asphalt at 77 degrees Fahrenheit shall be not less than 30 nor more than 40. The tar and asphalt filler shall be mixed with sand and used in the same manner as the coal tar or asphalt filler described in sections 13 and 14.

The secretary is also sending to the members to be voted upon a form of specifications for sidewalks and curbs. These include specifications for 2-course concrete sidewalks and 1-course concrete sidewalks; for curbs of granite, hard sandstone, bluestone and hard limestone, soft sandstone and limesone, and of concrete; also for pre-molded reinforced concrete curb. The curb specifications include provisions for setting the curb in concrete or gravel, and the use of drain tile under the curb.

SHEET ASPHALT SPECIFICATIONS

Several changes were recommended in the sheet asphalt specifications. Penetration for light traffic streets was changed from the limits of 55 to 85 to those of 45 to 70, and for heavy traffic streets from 30 to 55 to 25 to 45. A new provision was inserted that "The penetration shall be determined by the engineer within the limits indicated above and shall include a tolerance of 10 per cent either way of the penetration set for the particular street." Another new provision was: "Low spots or depressions in the foundation more than one inch below the grade thereof shall be filled and brought to grade with binder mixture and compressed prior to the spreading of the binder course. Compression must be effected by a roller if depressions are of a sufficient area, otherwise tampers may be employed."

In connection with laying the surface mixture, the following new provisions were inserted:

Loads should not be dumped any faster than they can be properly handled by the shovelers. . . . The shovelers shall not distribute the dumped load any faster than it can be properly handled by the rakers. The rakers will not be permitted to stand in the hot mixture while raking it, except where necessary to correct errors in the first raking. . .

Immediately after raking, the mixture shall be compressed by hot tampers where it adjoins the curbing, gutters, headers, manholes, etc., and in all places inaccessible to a roller. In all other places it shall be given its initial compression by rolling with a tandem steam roller weighing not less than 5 tons, as soon after being raked as it will bear the roller without undue displacement or hair cracking. Delays in rolling the freshly raked mixture will not be tolerated.

Unless otherwise ordered by the engineer, the rolling shall be conducted as follows: The initial compression shall be given by rolling in a direction parallel to the curb, after which the pavement shall be cross-rolled or diagonally and then straight rolled until a compression and contour is obtained which is satisfactory to the engineer. During the initial (and) (or) final compression of the pavement the rollers should preferably be operated at a speed of approximately one (100) feet per minute and when so engaged they will not be permitted to exceed a speed of one hundred fifty (150) feet per minute. Where necessary to moisten the roller to prevent the hot mixture from sticking to it, a mixture of kerosene and water should be sparingly applied to the large roll. With the permission of the engineer, steam or water may be substituted therefor, but the use of water in excessive amounts will not be allowed under any circumstances.

NOTE: Where the width of the street will not permit cross-rolling or where the type of construction renders it desirable, the engineer may change the method of rolling.

Where more than one hundred (100) square yards per hour of surface mixture are laid, two rollers will be required. Where two rollers are employed, a 5-ton tandem steam roller should be used for the initial compression and not lighter than an 8-ton tandem steam roller for the final compression. With the permission of the engineer, a three-wheeled steam roller may be used for the final compression. All rollers used shall be in good condition and shall weigh not less than two hundred (200) pounds to the inch width of tread. They shall be operated by competent and experienced roller engineers and must be kept in continuous operation as nearly as practicable in such a manner that all parts of the pavement shall receive substantially equal compression. During an 8-hour day each roller must be engaged in actual rolling for not less than 6½ hours, not more than 1½ hours being allowed for cleaning fires, watering, etc.

After the pavement has received its initial compression by rolling and before the close of the day on which it was laid, it shall have a small amount of Portland cement or limestone dust swept over it in order to give it a pleasing appearance and color. Except with the permission of the engineer, this shall not be done until the pavement shall have been rolled sufficiently to establish it and where back patching will be necessary and until any such defects have been so remedied. In no case shall the sweeping of cement

be carried on in such a manner as to permit the dust from it to blow or be carried on to the freshly raked mixture before it has been rolled.

Joints between old and new pavements or between successive days' work shall be carefully made in such a manner as to insure a thorough and continuous bond between the old and new surfaces. Except when a tope joint is used, the edge of the old pavement shall be cut back on a level so as to expose a fresh surface after which the hot surface mixture shall be placed in contact with it and raked to a proper depth and grade. Hot smoothers (and) (or) tampers shall be carefully employed in such a manner as to heat up the old pavement sufficiently to insure a proper bond without burning it.

The finished pavement shall have a contour substantially conforming to the grade set by the engineer and shall be free from any depressions which will hold water or which exceed three-eighths (⅜) of an inch in depth as measured between any two points six (6) feet apart in a line conforming substantially to the grade and contour as set by the engineer. It must be free from porous or rough spots that will remain wet after the balance of the surface has dried.

Provisions were also added as to the kind of plant that may be used for manufacturing the pavement material and the testing equipment that must be provided, these requirements being as follows:

Plant.—The plant used in manufacturing the pavement must be of the batch type and capable of mixing in the manner herein specified not less than 80 tons of surface mixture per day of eight hours and must be provided with separate chambers for heating and mixing the ingredients. The mixing shall be done in a twin-shaft mixer of the pug-mill type capable of holding and properly mixing not less than a 750-pound batch of surface mixture. Each plant must be provided with asphalt kettles of such capacity that one filling of them will be sufficient for a day's run. There shall also be provided a 6- or 8-mesh rotary screen not less than 6 feet long, capable of separating the coarse and fine aggregate and delivering each to a separate compartment bin; bins and screen to be provided with overflow pipes. The hopper into which the hot aggregate is drawn from the bin must rest upon a set of scales so arranged that a definite weight of material can be weighed out of the bin and delivered to the mixer.

The asphalt bucket used to measure and apply the asphalt must be balanced upon a set of scales and so arranged that the asphalt can be easily and quickly weighed and be applied in a thin sheet the full width of the mixer.

The plant shall be provided with an asphalt thermometer for the melting kettles, an electric pyrometer at the discharge chute of the drier, a platform scale and at least two inspectors' armored thermometers.

The different kinds of sand and stone used shall be kept separate and such provisions as are deemed necessary by the engineer to keep them from becoming mixed shall be made by the contractor.

Testing Equipment.—The contractor shall provide and maintain in good order at the plant the following testing equipment, which may be used by the engineer or an inspector designated by him to determine the penetration of asphalt and asphalt cement, the grading of the mineral aggregate and such other tests as are deemed necessary.

1 penetration machine with needles, glass dish and thermometer.

1 set of standard screens, 200, 100, 80, 50, 40, 30, 20 10 square mesh, ¼, ½, ¾, 1, 1½ inch circular openings.

1 laboratory sand scale.

1 roll of manila paper for making pat tests.

All of the above-mentioned apparatus shall be of standard type and approved by the engineer and shall be properly housed by the contractor in a separate building or room not less than ten (10) feet by ten (10) feet and provided with a work-bench. This room shall be used exclusively for testing purposes by the contractor and the engineer or his inspector.

BRICK PAVING SPECIFICATIONS

In the brick paving specifications the additional requirement is that "Adequate under-drainage shall be provided to remove rapidly all water from the sub-grade of the roadway, as provided in the specifications for sidewalks and curbs of the American Society for Municipal Improvements. Where required a similar cross-drain shall also be provided." Another new provision is that "All castings for manholes, catch basins, etc., shall not be imbedded in the concrete foundation. They shall be made to rest on top of the foundation to allow the pavement to expand uniformly, therefore avoiding the cracks and crushing of the bricks."

Provision is proposed for a mortar cushion in the following paragraph:

When properly graded sand cannot be obtained for cushion, the following cushion may be used. The sand and cement in proportion of one part cement to four parts sand shall be thoroughly mixed dry in a small batch mixer until it is of uniform color throughout. The mixture shall then be spread on the prepared foundation to a depth of one inch and shaped with a template to a true cross-section parallel to and four inches below the cross-section of the finished pavement. Bricks shall be laid, rolled and culled immediately following the placing of the sand-cement cushion. After the culling is effected, they shall then be well wet down and grouted as hereinafter specified in section 18-A of these specifications.

The proposed provision for asphalt filler is: The asphalt filler shall be homogeneous, free from water and shall not foam when heated to 200 degrees C (392 degrees F.). It shall meet the following requirements:

(1) Flash point not less than 200 degrees C.

(2) Melting point (ring and ball) 65 degrees C. to 100 degrees C.

(3) Penetration at 25 degrees C., 100 g., 5 sec., 30 to 40 or 40 to 50. Penetration at 0 degrees C., 200 g., 1 minute, not less than 10.

(4) Ductility at 25 degrees C. not less than 2.

(5) Loss at 163 degrees C., 5 hours, not more than 3 per cent.

(6) Total bitumen (soluble in carbon disulphide) not less than 95 per cent.

(7) Per cent of total bitumen soluble in carbon tetrachloride, not less than 95 per cent.

All of these changes have been submitted to the members under a provision of the society's constitution requiring a letter ballot for their final adoption by the society.

Refuse Collection In England

A few weeks ago the ministry of health of England conducted an inquiry in connection with the request of the borough of Great Grimsby for permission to purchase six electric vehicles for refuse collection and highway purposes and to erect a garage. In this investigation the following facts were brought out:

Refuse is collected from 17,755 houses amounting to 1,429 tons a week. In removing this refuse by horse-drawn vehicles the cost for labor alone had averaged $3.20 a load, a load averaging one ton. (In this article cost figures will be given in dollars on the basis of $5 to a pound.) The cost for the last half of 1920 was $55,000, and adding the destructor cost for burning the rubbish, amounted to one-quarter of the taxes raised in the district. The statement was made in the investigation that refuse collection and disposal in England cost $60,000,000 a year.

The borough surveyor estimated that the cost of running an electric vehicle per year was $350 for current, $185 for tires, $1,450 for interest and replacement, $100 for oil, waste and water, $92.50 for insurance, $967.50 for driver, $2,750 for three fillers; a total cost of $5,895, or $2.56 a ton, which would give a saving of 64 cents a ton. He proposed, after installing the six electric vehicles, to purchase an additional one each half year out of the revenue until they had twelve. The inspector thought the figures given should be modified, 6½ per cent interest on the $47,500 (cost of vehicles) and 7-year sinking fund amounting to $8,550 a year, maintenance of each vehicle $250, current $425 instead of $350, and drivers' wages $1,000 each. This would give the annual cost of the six vehicles, including fillers' wages and other items, as $37,980, or $6,330 each.

Quicksand

What it is and some of the peculiarities of its action in trenches, methods of handling it by bleeding, compressed air and other expedients, and the supporting power of such sand, are discussed by Col. Charles R. Gow.

The nature, behavior and methods of controlling quicksand were discussed by Col. Charles R. Gow, civil engineer and contractor, before the Holyoke convention of the New England Water Works Association. The principal points of Mr. Gow's paper are given in somewhat condensed form in the following paragraphs.

DEFINITION OF QUICKSAND

Mr. Gow began by stating that, contrary to popular ideas, quicksand, strictly speaking, is not a material but rather is a condition of a material which, under different circumstances, may possesses no such characteristics. Moreover, quicksand as such rarely occurs in nature, but usually is artificially produced by excavation or other acts of man. Stories of men and animals losing their lives by being "sucked" into quicksand beds probably have their origin in the mistaken application of the term to deposits of semi-fluid mud, silt or soft clay; also there may be isolated cases in which ground water rises to the surface through beds of fine sand and produces a natural quicksand.

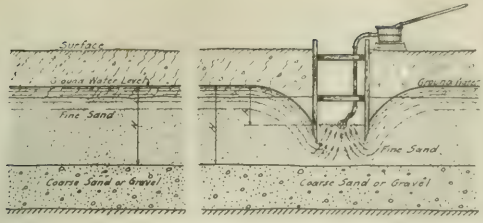
The author of the paper was convinced that fine sands under conditions of quickness act in strict accordance with well-recognized physical laws, and that many of the troubles encountered in operating in quicksand could often be avoided by the adoption of more scientific methods of handling. As perhaps the best and most inclusive definition of quicksand which Mr. Gow had seen, he quotes one given about twenty years ago by Allen Hazen—"A sand containing for the time more water than would normally be contained in its voids and therefore with its grains held a little distance apart so that they flow upon each other readily." When the water and sand are mixed but at rest, the several grains of sand rest one upon another and the voids in the sand mass are identical with those found in dry sand of the same composition, but filled with water instead of air. In order to displace any individual grain it will be necessary to overcome the frictional resistance of that particle upon its adjacent neighboring grains and the adjacent grains must also be displaced more or less in order to free the one in question. To accomplish this will require the application of a substantial amount of force.

When water passes upward through sand, the friction of the passing water upon the separate grains of sand either actually lifts them or tends to reduce the friction of one grain upon another, thus making displacement of the particles much easier of accomplishment. If the velocity of the water be sufficient to bring the particles substantially into a state of suspension, they offer practically no resistance against displacement and a body resting upon such sand will sink into it as it would into a semi-fluid material. In order to possess the qualities of quicksand, the material must approximate this condition.

It will be obvious that the smaller the individual particles of sand the easier it is for the water to lift them and hold them in suspension. Also the voids, generally speaking, will be smaller and more numerous in this case and the passage of water through them more difficult. The result is, therefore, that fine grained sand displays the quality of quicksand much more readily than does a coarse-grained material.

QUICKSAND IN TRENCHES

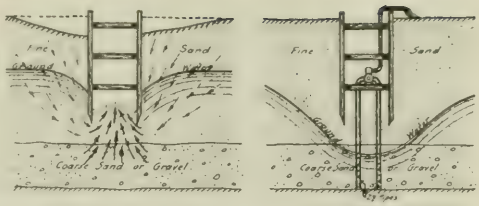
Figure 1 illustrates the unbalanced condition of ground water which occurs when an excavation is made into wet sand by the usual process. At the left is shown the assumed stratification of soil and the normal level of ground water. At the right is shown a sheeted excavation which has been carried below the ground-water level with the assistance of a pump which drains the inflow of water entering the opening. The drawing down of the water level at this point results in an unbalanced condition with respect to the surrounding ground water. That in the coarse stratum at the bottom of the section is under a pressure due to the head H. In the area immediately under the excavation, however, the upward pressure



NORMAL CONDITION OF WET SAND

UNBALANCED WATER CONDITION DURING EXCAVATION PROCESS

FIGURE 1



BOILING INDUCED BY UPWARD FLOW FROM COARSE STRATUM BELOW TRENCH

BLEEDING COARSE STRATUM TO PREVENT BOILING

FIGURE 3

from this stratum is resisted only by the pressure due to the head H-h, with the result that there is a flow of water upward into the excavated opening. Depending upon the velocity of this flow together with the character of the sand, there will result a condition of quicksand in the soil underlying the excavation.

If the sheeting is relatively watertight (as it must be to prevent the inflow of water and sand through its vertical joints), there may result an accumulation of water pressure immediately behind the sheeting which may produce such velocity of flow under the sheeting as to cause a break there, allowing sand to flow with the water through the passage thus formed, bringing a considerable quantity of sand from behind the sheeting and leaving a void there, which in turn is filled by the settlement of the ground above, as shown in Figure 2. This could be avoided by driving the sheeting to a greater depth in advance of the excavation. It will usually be found economical in such cases to employ matched or tongue-and-grooved sheeting, and to drive the same several feet below the required depth of excavation, in order to avoid disturbance of the adjacent banks and the removal of excessive amounts of material.

Under these same conditions an extremely fine-grained sand may assume semi-fluid tendencies due to the upward movement of water through it and there may be an upward movement of the sand into the trench so that a trench left overnight may be found the next morning to have filled up again to a depth of several feet. This tendency can be resisted by driving the sheeting deeper and by the free use of gravel or broken stone, which forms a surface layer or crust over the sand, permitting the water to escape, but preventing the numerous smaller boils whereby the sand is carried upward into the trench.

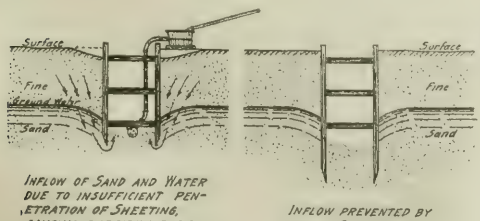
A more serious cause of trouble from quicksand is shown in Figure 3. In this case an upward flow of water from a coarse stratum below, caused by an unbalanced water head, carries the sand with it into the trench; which sand is replaced by adjacent sand on either side which flows in laterally to fill the crater thus formed. The result is a demoralizing of the surrounding ground surface and an inflow of sand through the bottom of the excavation, possibly as fast as or faster than it can be removed.

The further driving of the sheeting in such cases is ineffective unless it is carried down to the stratum of coarse material, and even then the boiling sand and water continues, although the adjacent ground is protected against undermining.

BLEEDING QUICKSAND

The most expeditious and satisfactory method for handling such cases is by means of the bleeding process illustrated in the right-hand view of figure 3. Perforated pipes or well points of sufficient size and number are driven into the coarse stratum and connected by a manifold to a pump of proper size. If the pump and well system have a capacity greater than the amount of inflow at this point, a depression can be formed in the surrounding ground water level to a point lower than the bottom of the excavation, thus permitting the latter to be carried on in the dry. This method is relatively inexpensive compared with the cost of handling a bad quicksand trench and is to be recommended whenever there occurs violent boiling from a lower level.

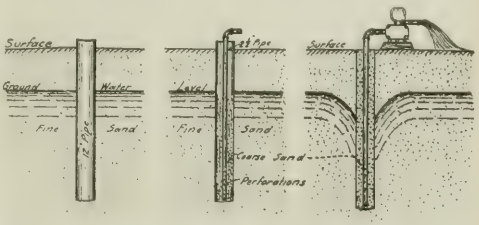
A somewhat similar but less dependable method of bleeding fine sand is shown by figure 4. Generally speaking, well points are not effective



INFLOW OF SAND AND WATER DUE TO INSUFFICIENT PENETRATION OF SHEETING, CAUSING SUBSIDENCE OF SURFACE ADJACENT TO TRENCH

INFLOW PREVENTED BY DRIVING SHEETING TO GREATER DEPTH

FIGURE 2.



METHOD OF BLEEDING FINE SAND

FIGURE 4.

in fine sand because the amount of water that can be drained by a single point is small, due to the slow percolation through it and the fineness of the gauze screening which prevents the sand from entering the pipe. To meet this condition, large pipes of, say, 12 inches in diameter may be driven, into which smaller well pipes are inserted, the annular space between them being filled with coarse sand. If the large pipe is then removed, the coarse sand will collect the water from the fine sand while still holding the latter in place, and will readily deliver the accumulated drainage to the well points in the lower end of the well pipe. If a sufficient number of these installations are connected in a given locality, the water in the fine sand may be drawn down as in the former case.

The author described the use of the pneumatic or compressed air process in sinking excavations through fine, wet sand. The air, exerting a pressure at the bottom of the excavation, forces the water back into the soil, and fine sand which perhaps had previously boiled violently because of inflowing water may require picking for its removal. Fine, wet sand deposits which offer almost insurmountable difficulties for open excavation may usually be tunneled by the use of compressed air with the utmost ease.

Mr. Gow citied an experience which he had several years ago where an upheaval of fine sand and water in the basement of a mill building resulted in serious damage to the structure. Test boring showed that there existed at that point a surface layer of a very compact clay hardpan overlying a bed of exteremely fine sand about twenty feet thick, and immediately under this a substantial layer of coarse gravel. This gravel was filled with water under such head that it rose in the boring pipe to a point fourteen feet above the level of the basement floor and several feet higher than the natural ground level. Several six-inch pipes were driven down to the coarse stratum and clear water allowed to flow through them so freely that the ground-water head was reduced below that required to force its passage upward through the fine sand, with the result that the flow of sand ceased entirely. Incidentally an excellent water supply was secured to the mill for manufacturing purposes.

SUPPORTING POWER OF FINE SAND

Concerning the supporting power of fine sand which may become "quick" when excavated into, Mr. Gow believed that such sand in its normal condition will sustain quite as great a foundation load as will coarse-grain sand. It is probably because such sand is ordinarily seen under the unatural condition cause by excavating into it, that so many people assume this unstable condition to be its natural state, while the contrary is in reality true. He has never hesitated to recommend loadings as high as four tons per square foot upon sand which, during the excavation process, permitted the workmen to sink to their knees in it, nor has there been any observable settlement in such cases, to his knowledge. Surrounding the foundation site with tight sheeting does not, in his opinion, increase the bearing value, although it may be useful in preventing subsequent lateral displacement in the event of adjacent excavations being made. If the material is a pure sand it will not flow under pressure alone except under excessive loading, although if the sand contain a considerable quantity of clay this may not be so. A microscope may be required to determine accurately whether the finest particles are sand or clay.

The production of quicksand characteristics by introducing water under pressure may be employed to advantage in driving piles in fine sand by using the water jet method, and this is recommended for driving either bearing or sheet piles into fine sand.

SEWERS AND DRAINS

Quicksand frequently causes trouble by escaping into sewers, drains or other underground conduits, thus clogging them and producing voids in the ground which must be filled by settlement from above. Consequently any open pipe or conduit laid through wet sand should be constructed with special care to exclude the surrounding sand. When drains are laid in such material for the purpose of lowering the ground-water level, the open joints should not only be wrapped in cloth to exclude the sand, but the entire pipe should be surrounded with soft-coal cinders. Such cinders form one of the most useful agents for admitting water while still excluding the passage of sand. They are useful during the process of excavating in quicksand, a frequent liberal sprinkling of them over the bottom of the trench being found very effective in preventing the workmen from sinking into the sand.

It will be found that the ordinary garden fork is more effective for handling many quicksands than is the type of shovel usually employed, owing to the fact that fine, wet sand has a very pronounced suction which causes the blade of the shovel to stick and requires considerable force to remove it.

Another Isthmian Canal Proposed

Secretary Baker has suggested that it is time to begin planning another canal across the Isthmus of Panama, since within the next 15 years the capacity of the present canal will, he believed, have been reached. Anticipating a renewal of the discussion of lock versus sea-level canal, he speaks in favor of the latter. The two chief arguments against the sea-level canal are the additional cost and the additional time required for construction. The latter can be offset by beginning construction soon enough to permit its completion by the time the capacity of the present canal is reached; and as for cost, since the World's War a few hundred millions would not stand in the way of the construction by the American people of whatever it considered best. It is possible that the Nicaraguan route might be chosen.

PUBLIC WORKS

Published Weekly
by
Municipal Journal and Engineer Inc
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates

United States and Possessions, Mexico and Cuba ...$3.00 per year
All other countries .....$4.00 per year

Change of Address

Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

CONTENTS

SEWER CONSTRUCTION IN KOKOMO, IND.—Illustrated 89
Development of the Port of New York 91
CHANGES IN NEW YORK'S BUILDING ZONES By Edward M. Bassett 92
A Traveling Gravel Plant 92
FLEXIBLE PAVEMENT BASES—Illustrated 93
City Planning for Kansas City 95
New York City's Preparations for Snow Removal 95
PAVEMENT SPECIFICATIONS OF THE A. S. M. I. 95
Refuse Collection in England 97
QUICKSAND—Illustrated 98
Another Isthmian Canal Proposed 100
EDITORIAL NOTES 101
Measurement of Contract Work
Extension of New York State Highways 102
New England Road Builders' Association 102
New York State Highway Commissioner 102
Sanitary Engineers' Dinner 102
A Russian-American Engineering Society 102
HOW CAN A GENERAL CONSTRUCTION ORGANIZATION BE UTILIZED DURING WINTER SHUT-DOWN? 103
Irrigation Project for Manila 104
PAYMENT FOR SEWER MANHOLES 105
RECENT LEGAL DECISIONS 106

Measurement of Contract Work

One of the most important characteristics desirable for specifications is that of eliminating all opportunities for misunderstanding between the parties to the contract. Probably one of the most prolific causes of discord between engineers and contractors has been disagreement in the interpretation of certain points in the contract and specifications or in adjusting differences due to omissions.

In the case of itemized bids, it should be made perfectly clear just what is included in each item bid upon; and the sum of all the items should equal the completed work. For any part of the work not so included the contractor is entitled to additional payment as extra work, and extra work not only affords basis for dispute, but it furnishes ground for criticism of the engineer by his employer.

The above was suggested by the letter printed elsewhere in this issue, in which a contractor states that a dispute concerning payment for a sewer job has arisen because of failure of the specifications to state clearly just how manholes are to be paid for; the contractor claiming that payment for the sewer should be for the entire length from one end of the line to the other, including that under the manholes, while the engineer would deduct from the length of sewer paid for those sections which lie within the manholes. As a matter of fact, in this case it perhaps makes little difference which method of payment is adopted, providing it is made perfectly clear to the contractor before bidding just what will be the basis of payment.

In some cases exact definition of the basis of payment is omitted because it is assumed that trade or local practice determines this; for instance, the general practice of paying for brick or other masonry in house construction by the total area of wall, including windows or other openings. It is safer, however, to specifiy such matters even though they may be commonly accepted. For one reason, an outside contractor might claim truthfully that he was unfamiliar with such local custom and had bid in ignorance of it and would be injured by its application to his contract.

Another desirable characteristic of those clauses of specifications which refer to measurement of work done is simplicity and elimination of variable or uncertain conditions. This is illustrated by the case of sewer and manhole payments just mentioned. If deductions are made from the sewer length for the distance included within manholes, the length for payment would be determined undoubtedly by measuring the total length and deducting therefrom the several lengths included within manholes. This not only increases the amount of work but furnishes an opportunity for mistakes and, as we can see no arguments in favor of this plan rather than the other, the simpler one seems to us the better and wisely chosen as the standard practice.

The principle of including all items might well be carried further than it commonly is. In some contracts for trenching and other excavating work a lump sum is bid for pumping or otherwise removing ground water which may flow into the trench, while in perhaps the majority of cases no payment is made for this but the contractor is supposed to distribute its cost among the other items. The same is true of sheeting trenches in unstable soil or where the depth is excessive. In the latter case the payment is frequently made on the basis of lineal feet of trench which must be sheeted. It would seem to be equally logical to base payment for pumping or other form of de-watering on the length of excavation which requires this, on the size of pump and hours of pumping required, or some other unit which would give a more or less definite measure of the amount of work of this kind required of the contractor.

The more uncertainty there is left in a contract the more it becomes a gamble for both contractor and those paying for the work. Some men are natural gamblers, and some contractors enjoy and grow rich on gambling contracts. The average employer of contractors, however, is so only occasionally and is therefore at a disadvantage in any gamble between the two, but should in wisdom pre-

fer a straight, plain business agreement in which there will be no misunderstanding and in which both parties will secure a reasonably good bargain. Such a business agreement required that every item of work to be performed is so definitely and unmistakably described that at no time during the conduct or final closing up of the contract will any dispute arise as to its meaning.

New England Road Builders' Association

An association of firms or corporations actively engaged in road building work in New England was formed on January 13, with about 60 charter members. The meeting voted that the first duty of the executive board be to take up with the commissioners of the Massachusetts State Highway Division suggestions relative to changes and improvements in the specifications under which roads are now being built in Massachusetts. The following officers were chosen for the year 1921: Ransom Rowe, president; John F. Coleman, vice-president; Joseph A. Tomasello, treasurer; Samuel Hobbs, acting secretary. The executive board consists of the president and Joseph M. Bryne of Boston, C. B. Lindholm of Pittsfield, Arthur A. Adams of Springfield, C. J. Spalding of Worcester, J. J. Welch of Salem, C. J. Reynolds of Canton, and E. J. Rourke of North Abington. The address of the secretary is 68 Devonshire street, Boston.

New York State Highways

Although the New York State Highway administration, with the new superintendent of highways, may not see fit to adopt it, a committee appointed in 1919 has recently submitted a report for completing the state highway system, the estimated cost of which would be about $82,000,000. $53,000,000 is made available by the 1920 bond issue, federal aid, state appropriations and the counties' share of the cost of construction. The remaining $29,000,000 could be provided by direct appropriations, bond issues, or future federal aid. The system designed contemplates linking up all the roads in the state and providing 8 through routes across the state from east to west, and 21 from north to south, requiring 11,119 miles of road, of which 10,380 miles were authorized in 1917 and 8,000 of which have already been built. This would require somewhat over 700 miles of new roads to complete the system, and would require possibly six years to complete the construction.

New York Highway Commissioner

Governor Miller has appointed former state excise commissioner, Herbert S. Sisson, as New York State Highway Commissioner in place of E. S. Greene, appointed three years ago by former Governor Smith. The American Association of Engineers unavailingly petitioned the governor to put an engineer in Mr. Greene's position.

Sanitary Engineers' Dinner

Last year, at the suggestion of J. Frederick Jackson, director, Bureau of Sanitary Engineering, Connecticut State Department of Health, a group of sixteen sanitary engineers held a dinner at the Hotel McAlpin on the evening before the annual meeting of the American Society of Civil Engineers for the purpose of an exchange of views, a recital of experiences and for an opportunity to meet socially.

The affair was so enjoyable that it was decided to repeat it this year and on the evening of January 18, 1921, twenty-nine met together at the same place.

Among the many topics of live interest that were discussed informally were: The situation regarding water supply and sewerage at Athens, Greece; the experiments with a new type of Schaefer ter Meer sludge centrifuge and the use of acid in the treatment of activated sludge at Milwaukee; fine-screening at Milwaukee, Baltimore, Rochester and Syracuse; the electrolytic process at Allentown, Pa., and Elmhurst, N. Y.; the pollution of the new municipal swimming pool at Washington and, as indicated by dissolved oxygen, of New York harbor; the admission of storm water to sanitary sewers and of sewage to storm drains at Newark, etc., etc.

It was decided to establish the custom of meeting in this way and at this time every year.

Those present were: Walter E. Spear, New York City; John F. Skinner, Rochester, N. Y.; Edw. B. Besselievre, New York City; F. C. Wintermute, Wilkes-Barre, Pa.; Weston Gavett, New York City; R. H. Craig, New York City; W. H. Halsey, Southampton, N. Y.; Lynn Perry, Easton, Pa.; Amos Schaeffer, New York City; R. F. Proctor, Baltimore, Md.; Kenneth Allen, New York City; Ezra B. Whitman, Baltimore, Md.; G. L. Robinson, New York City; R. K. Tomlin, New York City; J. R. Van Duyne, Newark, N. J.; A. S. Hirzel, Wilmington, Del.; E. F. Koester, Wilmington, Del.; T. C. Hatton, Milwaukee, Wis.; A. E. Phillips, Washington, D. C.; W. Gavin Taylor, Newark, N. J.; Edw. S. Rankin, Newark, N. J.; T. J. McMinn, Bridgeport, Conn.; Geo. A. Soper, New York City; Harrison P. Eddy, Boston, Mass.; J. F. Jackson, New Haven, Conn.; R. Spurr Weston, Boston, Mass.; A. H. Pratt, Newark, N. J.; A. W. Tidd, New York City; C. L. Bogert, New York City.

A Russian-American Engineering Society

Russian engineers in the United States in 1918 founded the "Russian Engineering Society in U. S. A." and in 1920 this became affiliated with the United Engineering Society and has its offices in the United Engineering building, 29 West 39th street, New York City. It is a purely professional organization with 91 members.

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that ohters who have solved similar problems different will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

How can a General Construction Organization Be Utilized During Winter Shut-Down?

Office force can investigate, design and improve; prepare, classify and tabulate data and sometimes can revise contracts. Equipment can sometimes be put on production or extra service. Mechanics can be put on Repairs and Construction.

A very important part of the general contractor's investment, whether large or small, consists of his organization and equipment, both of which involve heavy overhead and fixed charges that run day and night, involving a large constant expense, whether or not he is doing any work on which regular estimates will bring him monthly payments. In fact, not only his own time and his whole capital, but all of his obligations demand direct or indirect constant outlay or payments of some kind whether work is going on or not, and much of it cannot be avoided or diminished even if all of the work is totally suspended; so that a short period of non-compensated time seriously reduces and may eliminate the net profits for the year, even if the contracts themselves are good and conditions generally favorable.

Most contractors experience more or less dull or idle time, especially in the winter, and thereby suffer heavy losses that might be considerably reduced by careful analysis, planning and energetic action. Producers, manufacturers, dealers and most employees are busy the year around, because they recognize that they would be badly crippled or ruined by idle periods, and, if necessary, make sacrifices and strenuous efforts for continuity of business. The contractor should strive as earnestly for uninterrupted, comfortable employment for his men and plant and can secure it to a larger degree than is generally realized.

SOME YEARLY SALARIES NECESSARY

It is so difficult to secure satisfactory men for positions of responsibility, it takes so long to train them and it is necessary to have them so promptly for important work, that allowance must be made in overhead charges, distributed on estimates and bids, for keeping the best foremen, superintendents, and a few office men and sometimes first-class workmen, over the intervals between one job and another. These men will be more contented and efficient and it will be very much more profitable to the contractor, if employment be found for them than to have them idle, and there are many ways in which employment can be made advantageous, chiefly by doing necessary things that can be attended to before or after the busy construction period when time is limited and important duties are urgent.

ANTICIPATING INVESTIGATIONS

Inquiry among public officials, corporations, and former clients or their friends will often discover future work that has not yet been announced, and the contractor's estimator or assistant engineer may be able to make reconnoisance of the territory, study transportation and facilities, investigate local conditions; prospect for stone, gravel, timber, water, transportation, and even indirectly for labor; make borings; and investigate local conditions so as to make a far more intelligent bid and develop special features that could not be done in the brief time often allotted to the preparation of a bid, after the invitations have been issued. This work, of course, is a good deal of a gamble and should not be undertaken expensively unless there is strong probability of a favorable opportunity to bid in the near future.

REVISING DESIGNS

If engineers and owners can be persuaded to issue specifications and plans in advance, or to old friends confidentially, the contractor and his staff can profitably study them very critically and note wherever immaterial changes could be made so as to allow the use of materials, supplies, machinery or equipment that is cheaper, more convenient or more easily obtained by the contractor; to use different grades or sizes and eliminate small quantities, odd sizes or special materials that are difficult to obtain, or substitute an equally good article or modify some of the methods or requirements without in the least injuring the construction or the owner's interests, while it expedites the work and is advantageous for the contractor. Many of these changes, if properly presented, will be entirely acceptable to the owner and engineer, and others may be made by way of exchange, the contractor offering some concession or advantage to compensate for the favors granted him. A state of willingness to reciprocate, and an honest effort

to do first-class work, will generally be appreciated.

FINISHED AND UNFINISHED WORK

For unfinished work, future operations should be very carefully studied and scheduled and all operations listed in order, with the probable date of commencement and completion, the number of men and the plant and materials required at the given date in order to avoid all delay, confusion or interference. These data should be carefully classified and arranged and placed in a follow-up calendar showing each day what steps should be taken, arrangements made or initiated, orders given, and reports prepared to insure that everything and everybody will be in readiness without fail when required.

Orders for supplies should be ready to be mailed at the proper time and to be followed up for prompt delivery, and arrangements made for receiving, inspecting, storing and distributing the supplies. Possible difficulties should be anticipated, emergencies provided for and very careful studies made of the methods and sequence of operations and of the installation and service of the plant and equipment, which will often develop changes, arrangements, and convenient devices that will make the work safer or more rapid, will eliminate hand labor or prevent delay and loss of time. All data required in the field should be verified, arranged and tabulated in convenient duplicate form so that the foremen and superintendents can have them constantly available and refer to them instantly by inspection without stopping to make calculations in the field.

If it has not already been done, the records of previous work can be analyzed and summarized, classified costs prepared for future estimates, and in particular the time required for certain operations under given conditions and the amount of men and plant employed on it, and these recorded so as to be available for future comparison and quick estimates.

SUPPLEMENTARY WORK

If other construction work, heavy manufacturing or production is going on in the vicinity, the contractor may be able to secure sub-contracts or arrange to render special services that will keep some portion of his plant, such as derricks, hoisting engines, excavating machinery, drills, trucks and the like busy even at a small profit and thus keep the equipment and its operators employed, pay overhead expenses and avoid disorganization of his forces. Motor trucks may be utilized for transportation, commercial or industrial purposes.

If supplementary work is required for the next season's operations, much of it, like building service roads and tracks, locating, opening and operating sand and gravel pit and quarries, building camps, clearing land, grading, draining and the like can be done during the winter; timber can be framed, concrete forms built, and storage bins and other facilities constructed.

REPAIRS AND CONSTRUCTION OF EQUIPMENT

At the contractor's yard all of the plant and equipment, from steam shovels and locomotives down to hand tools, should be carefully overhauled, inspected, repaired, tested, protected and accurately listed. Worn out equipment should be disposed of and all deficiencies made good.

A few mechanics and helpers, according to the size of the organization, can usually be very profitably employed in this way and often can build special or standard equipment that is certain to be required in the near future. Timbers for wooden derricks, jinpoles, shear legs, gantries, and the like can be framed and the blacksmith can forge the necessary fittings or can modify those left over from other equipment or scrapped plant.

Dump cars, wagon boxes, buckets, skips and the like that always receive hard service and wear out rapidly, should be repaired, reinforced and put in perfect order. When the complete articles are in bad condition the uninjured separate irons and other trimmings may be removed and serve for new plant.

SHOP AND YARD FACILITIES

An available building, or if necessary a new shed, should be provided equipped with work benches, a forge, drill press, lathe, grindstone, emery wheel, bolt cutter, borer, saw, and planer, all of which, with a little care, can be secured at a very moderate price and can be operated by electricity, by a gasoline motor, or even in case of necessity, from a shaft driven by an engine of an automobile truck. With such an outfit wood work can be done right and simple iron work can be done promptly and cheaply that would be very slow and expensive if sent to a machinist; new ideas and convenient devices can be worked out practically, and much time and money saved.

In such a shop small sectional wooden buildings can be manufactured ready to put together for field offices and store rooms; simple trusses, templates, batch boxes and arch centers can be built, trestles and runways prepared, tool boxes built and filled and small tools and supplies examined and sorted, prepared and stored to great advantage.

Dry, safe yards should be provided, close to a railroad siding, if possible, with loading facilities, skids and shelters for storing heavy plant and equipment on interrupted jobs or at headquarters or at sub-stations in remote places where plant is held for sale or re-shipment. The mechanical apparatus should be safe from thieving and mutilation, under cover or, if necessary, protected by heavy tarpaulins. Lumber and timber, including derricks and framed plant, should be protected from rain, kept away from contact with the soil, and provided with abundant ventilation and exposure to wind and light.

Irrigation Project for Manila

The Philippine government is contemplating issuing $25,000,000 in gold, non-taxable, 20-year, 3½ per cent bonds for irrigation and other public works, conditioned upon the permission of Congress. The chief object would be the construction of extensive irrigation and flood control works in Luzon and some of the other islands.

Payment for Sewer Manholes

Customary methods of estimating amounts due contractor for sewers and manholes.

Editor, PUBLIC WORKS,
New York City.
Dear Sir:

What is the customary way to pay for a manhole on a brick sewer? When a contractor bids, say, $10 per lineal foot for a 6-foot brick or concrete sewer and $50 each for manholes complete, has the engineer in charge of the work a right to deduct the footage taken up by the manhole, and is his contention that a manhole means from the bottom of the brick sewer to the top of the manhole correct? The specifications or bidding sheet did not cover the point in question clearly. The contractor claims that he should be paid regular price per foot and also his $50 each for manholes, claiming that the manhole in such cases means from the top of the sewer up to and including the cover and ring.

In reply to this question from an Ohio contractor, we stated that, if the specifications and bidding sheet did not cover the point, the court would probably hold that payment would be made in accordance with customary practice and would receive evidence as to what such practice was in that section of the country. While there may be practice in that particular locality at variance with that of the country at large, we believe that the latter is very generally in favor of the contention of the contractor. The very general practice, we believe, is to make measurements of all sewers continuous, whether these sewers be small pipe sewers or large brick or concrete ones.

As to the method of paying for manholes, not so great uniformity seems to obtain, although in probably the majority of cases the plan is to pay for the manhole a lump sum either for all masonry or for the masonry and iron top combined; or in some cases to pay a lump sum for a minimum height of manhole, plus a stated sum for each additional foot, the height being measured from the top of the manhole masonry to the invert of the sewer

Standard specifications for sewers have been adopted by the American Society for Municipal Improvements, the committee preparing them being also members of the committee on sewer specifications of the American Society for Testing Materials. These specifications state definitely how the sewers shall be measured, giving separate specifications for brick, concrete and pipe sewers; and in each of these cases it calls for continuous measurement without any deduction for manholes or other structures. For concrete sewers, the specifications for measurement read: "The length of concrete sewers will be determined by measurements along their inverts parallel to their center lines. No deduction will be made on account of openings at branches and manholes." Under the head of brick sewers it is specified that "The measurement of brick sewers shall in all respects conform with the requirements hereinbefore specified for concrete sewers." The specification for measurement of pipe sewers reads: "The length of pipe sewers to be paid for will be determined by measurement along their invert lines, and no deduction will be made on account of openings at manholes."

In these specifications the bids for manholes are supposed to be a lump bid for the manhole complete, so that no specifications are given for measurement.

In the matter of branches, either branch sewers or house connections, the specifications are as explicit as for sewers. For brick or concrete sewers it is specified that "The measurement of a branch concrete sewer will be made from the inner surface of the wall of the main sewer to which it connects. A reducer will be paid for at the contract price for the sewer at the larger end thereof." In the case of pipe sewers, measurements of branch sewers are not dealt with, but the practice of the writer and most other engineers with whose work he is familiar is to begin the measurement of each branch from the center of the manhole where it joins the main sewer. The A. S. M. I. specifications specified in the case of basin connection, that "the length of such connections paid for will be the total length measured along the invert of the connection." In the case of house connections, "They shall be measured from the hub of the spur attached to the drain, sewer or riser."

The above practice as to measurement of sewers would seem to be best from several points of view. It simplifies the estimate and avoids the necessity of making allowances which might easily give rise to dispute between engineer and contractor. In the case of pipe sewers, with the manhole already built, there is still additional work connected with adjusting the sewer to the inlet and outlet sides of the manhole which adds at least as much to the cost of construction as would the laying of the 5 or 6 feet of sewer which the manhole displaces. In the case of a brick or concrete sewer, the special work connected with facing the opening in the arch of the sewer over which the manhole is placed and making a strong joint between the manhole and the arch of the sewer generally adds as much to the contractor's cost as is saved by the material omitted from the sewer arch at the manhole.

After all, however, the important thing is to have it stated definitely and without possibility of misunderstanding just what is to be included in the payment for the sewer and what in the payment for the manhole, and the contractor can then adjust his prices for manholes to meet this understanding. Any specification which fails to make such definite provision for payment for manholes, basins, house and other connections, spurs and branches of all kinds, and all other appurtenances and additions to the uniform and continuous sewer conduit, is only inviting a dispute between engineer and contractor which tends to keep alive the unfortunate antagonism too often found between these two classes of men who should co-operate toward the securing of the best possible construction of our public works.

Recent Legal Decisions

NEWS STANDS AS OBSTRUCTIONS IN CITY STREETS

In a decision holding that news stands 2 feet wide on sidewalks in the city of Buffalo, though attempted to be authorized by the city, are unlawful obstructions, the New York Appellate Division, People v. Buck, 193 App. Div. 262, 184 N. Y. Supp. 210, states that it is elementary law that the public is entitled to the free and unobstructed use of the city streets, and that any obstruction of such streets for private use interferes with the public right, constitutes a nuisance, and may be removed at the suit of the interested citizen. There are certain exceptions to this general statement, as where there are temporary obstructions, or obstructions which the courts have considered as not amounting to a substantial interference with traffic, and as permissible and not in conflict with the purposes for which streets and highways are maintained. It is stated in elementary works on Municipal Corporations to be a diversion of the public streets for private use to permit them to be used for news stands. The primary purpose of streets is for the use of the public for travel and transportation, and any private obstruction or encroachment which interferes with such use is a nuisance.

Under these general rules it has been repeatedly held that storekeepers cannot use any part of the sidewalk for their showcases, show windows and other like purposes, as the right of the public is absolute and paramount, and the public has the right to the use of the entire street. There are exceptions, of course, as where the obstructions are for a public use, like hitching posts, stepping stones, watering troughs and things of that kind. In the present case the defendants to the action of mandamus requiring the removal of 25 news stands from the public streets of Buffalo based their argument chiefly upon the proposition that news stands have now become a public use, or a public benefit, which justifies their existence upon public streets.

The Appellate Division based its decision upon the authority of the only case in the state of New York which had been cited by counsel, or which the court had been able to find, involving the question of the legality or illegality of a news stand upon a public street. That is the case of People ex rel. Pumpyansky v. Keating, 168 N. Y. 390, 61 N. E. 637. That was a holding of the New York Court of Appeals that a municipality could not legally grant a permit for the erection and maintenance of a news stand upon a public street, except in accordance with the provisions of the statute which authorizes the common council of the city of New York to grant permits for the erection of news stands under the stairways of elevated railroad structures, a space already appropriated to the use of the railroad, and from which the public were excluded.

SUBCONTRACTOR'S RIGHTS UNDER CONTRACTOR'S BOND

The New Hampshire Supreme Court holds, William H. Tower & Co. v. Long, 111 Atl. 311, that where a contract for city improvements requires the contractor to furnish a bond for faithful performance, a provision in the bond, requiring the contractor to pay for all labor and materials furnished, is binding on the contractor and his surety, though it was not contained in the original contract. The city has authority to require the insertion of such a clause in the bond for its own protection, if for no other reason, without express statutory authority. Those who have furnished materials used in the construction of public works, and for which the principal contractor has not paid, have the right to enforce payment under the bond by action directly against the bondsmen, although they had no knowledge of the promise when made, or had not expressly assented thereto before bringing the action, and the right to enforce such contract for their benefit continues while the bond is in force.

MUNICIPALITY'S POWER TO SELL DISUSED PROPERTY

A municipal corporation may be the owner of two classes of property. One class includes all property essential to, or even convenient for, the proper exercise of municipal functions and corporate powers. The other class includes all property held for general convenience, pleasure, or profit. The corporation has usually power to dispose of the latter class of property. As an authority says: "Municipal corporations possess the incidental or implied right to alienate or dispose of the property, real or personal, of the corporation, of a private nature, unless restrained by charter or statute." A Dillon on Municipal Corporations, par. 901. The Arkansas Supreme Court, Fessell-Graham, Anderson Co. v. Forrest City, 224 S. W. 745, holds that a city has authority to sell a lot with a two-story brick building on it, which has been used as a city hall and for other municipal purposes, but which has been abandoned because, on account of its location and physical condition, it can no longer be used to advantage or with economy for such purposes.

LIABILITY OF SUBSCRIBERS TO HIGHWAY FUNDS

The Michigan Supreme Court holds, North Star Township v. Cowdry, 179 N. W. 259, that a subscriber to a highway fund was estopped to question the power of the township to spend the money in connection with certain money of its own; the money having been expended on the designated improvement, and all other subscribers having paid. One who has received benefit under a contract with a town cannot escape payment therefor on the ground that the contract was ultra vires.

NEWS OF THE SOCIETIES

Jan. 31-Feb. 4—ROAD SCHOOL, WISCONSIN HIGHWAY COMMISSION. 10th annual meeting. Madison.

Jan. 31-Feb. 5—NATIONAL BRICK MANUFACTURERS' ASSOCIATION AND COMMON BRICK MANUFACTURERS' ASSOCIATION OF AMERICA. Joint meeting. Hotel Pennsylvania, New York City.

Feb. 1—CLEVELAND SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Cleveland Engineering Society's rooms.

Feb. 1-2—NEW YORK STATE ASSOCIATION OF BUILDERS. Convention. Rochester, N. Y.

Feb. 2—SOCIETY OF AUTOMOTIVE ENGINEERS. Hotel Morrison, Chicago.

Feb. 1, 2, 3—ONTARIO PROFESSIONAL MEETING in conjunction with the annual meeting of the Engineering Institute of Canada. Toronto.

Feb. 4—CANADIAN SECTION, AMERICAN WATER WORKS ASSOCIATION. 1st general meeting. King Edward Hotel, Toronto. Secretary-treasurer, H. G. Hunter, Montreal.

Feb. 7—PORTLAND, OREGON SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

Feb. 7-8—FLORIDA ENGINEERING SOCIETY. Annual meeting. Lakewood, Fla.

Feb. 8—BOSTON SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Feb. 9-12—AMERICAN ROAD BUILDERS' ASSOCIATION. Eighteenth annual convention, eleventh American Good Roads Congress and twelfth National Good Roads Show, Coliseum, Chicago, Ill.

Feb. 10—SOCIETY OF AUTOMOTIVE ENGINEERS, Hotel New Southern, Columbus, O.

Feb. 11-12—ENGINEERING SOCIETY OF WISCONSIN. Annual meeting, Madison. Secretary, Leonard S. Smith, Madison, Wis.

Feb. 14-16—NATIONAL CIVIC FEDERATION. 21st annual meeting, Hotel Astor, New York.

Feb. 14-16—AMERICAN CONCRETE INSTITUTE. Annual meeting. Auditorium Hotel, Chicago, Ill. Secretary, Harvey Whipple, New Telegraph Building, Detroit, Mich.

Feb. 16-18—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Seventh midwinter convention. Engineering Societies' Building, TION, AMERICAN SOCIETY OF New York City.

Feb. 23—NEW YORK SECTION, AMERICAN SOCIETY OF CIVIL ENGINEERS. Meeting postponed from Feb. 16.

Feb. 28—PHILADELPHIA SECMECHANICAL ENGINEERS. Engineers' Club of Philadelphia.

Feb. 28—CHICAGO SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

March 14—AMERICAN ASSOCIATION OF ENGINEERS. The third annual railroad conference. Chicago.

April 27-29—UNITED STATES CHAMBER OF COMMERCE. 9th annual meeting. Atlantic City, N. J.

May 9-11—AMERICAN ASSOCIATION OF ENGINEERS. 7th annual convention. Buffalo.

May 17-19—NATIONAL FIREMEN'S ASSOCIATION. Twenty-third annual convention. Fort Wayne, Ind.

June—CONFERENCE OF MAYORS AND OTHER CITY OFFICIALS, State of N. Y. 12th Annual Conference. Elmira, N. Y.

June 6-10, 1921—AMERICAN WATER WORKS ASSOCIATION. Annual convention at Cleveland, Ohio. Secretary, J. M. Diven, 153 West 71st St., New York.

June 7-9—NATIONAL FIRE PROTECTION ASSOCIATION. Annual meeting. San Francisco, Cal.

Oct., 1921—IOWA SECTION AMERICAN WATER WORKS ASSOCIATION. Seventh annual meeting. Omaha, Neb.

AMERICAN SOCIETY OF CIVIL ENGINEERS

The annual meeting of the American Society of Civil Engineers opened on January 19, at the Engineering Societies building, New York City, with President Arthur P. Davis in the chair. The meeting opened with the report of the board of direction, after which the following members to the nominating committee were elected to serve for the coming year: W. T. Chevalier, A. L. Johnson, J. H. VanWagenen, George H. Tinker, F. E. Weymouth, J. H. Brillhart and T. H. Menas. The following committees then reported in detail the committee on the bearing value of soils, represented by R. A. Cummings; the committee on stresses in railway track, by Prof. A. N. Talbot; the committee on highway engineering, by H. Eltinge Breed; and the committee on bridge design and construction, for which a progress report was given by H. B. Seaman.

It was voted to discontinue the board of external relations, and to have matters of external relations handled by the board of direction sitting as a committee of the whole and that local committees be named to work with the board members in their districts, in order to secure co-ordinated action. The committee on the revision of the constitution was continued and instructed to present its report in time for the next annual convention.

It was announced that the board of direction had accepted the offer of the *Engineering News-Record* to contribute $2,000 for the establishment of a memorial to Arthur M. Wellington, an award to be made each year for the best paper submitted on any subject relating to transportation. Prizes were then awarded for papers published by the society from January, 1918, to May, 1920, inclusive.

The following officers were elected: President, George S. Webster, of Philadelphia; vice-presidents, E. E. Wall, of St. Louis; Andrew M. Hunt, of New York; and Frank G. Jonah, of St. Louis; treasurer, Otis E. Hovey, of New York; and directors, district 1, John P. Hogan, New York; Ira W. McConnell, also of New York; district 4, Richard L. Humphrey, Philadelphia, Philadelphia; district , Baxter L. Brown, of St. Louis; district 10, Frank T. Darrow, of Lincoln, Neb.; and district 11, George G. Anderson, of Los Angeles.

SAN FRANCISCO SECTION, AMERICAN SOCIETY OF CIVIL ENGINEERS

At the annual meeting of the San Francisco section of the American Society of Civil Engineers, the following officers were elected for the ensuing year: President, F. R. Muhs; vice-president, Thomas H. Means; secretary-treasurer, Nathan A. Bowers. At this meeting the following addresses were delivered: "Economic Aspects of the Present Situation," by Wigginton E. Creed; "Modern Hydraulic Equipment," by E. C. Hutchinson; and "Successful Methods on Rush Construction," by Rex C. Starr.

ILLINOIS SECTION, AMERICAN SOCIETY OF CIVIL ENGINEERS

At a meeting on January 13, the Illinois section of the A. S. C. E. elected C. B. Burdick president for the ensuing year. J. N. Hatch was elected vice-president for two years. The other officers, A. J. Hammond, vice-president, and W. D. Gerber, secretary-treasurer, each have another year to serve.

PHILADELPHIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The Philadelphia section of the A. S. M. E. held a meeting on January 21 in the form of a symposium on Hydro-Electric Power and Distribution, held under the auspices of the Engineers' Club of Philadelphia and the Philadelphia section of the A. S. M. E., A. S. C. E., and A. I. E. E.

The following subjects were discussed: "The Modern Hydraulic Turbine," by Frank H. Rogers; "The Application of a New Method of Water Measurement in the Efficiency Tests of the 37,500 h. p. Turbines of the Niagara Falls Power Co.," by Norman R. Gibson; "Surges in Conduits and Other Hydraulic Problems," by Raymond D. Johnsor; "The Present Trend of Hydraulic Turbine Development," by Lewis F. Mood; "Niagara Falls Power Development and Its Products in Philadelphia," illustrated by moving pictures, by John L. Harper; and "Electrical Features of Hydro-Electric Power," by David B. Rushmore.

AUTOMOTIVE ENGINEERS

The annual meeting of the Society of Automotive Engineers was held in New York January 11-13, routine business was transacted, papers and discussions presented before different sections on body engineering, commercial aviation, and chassis. There were also held sections of aeronautic engineering, fuel and highways. A carnival and a dinner in the grand ballroom of the Hotel Astor. The standard committee made reports under headings of aeronautics, ball and roller bearing, electric transportation, electrical equipment, engines, miscellaneous, motorcycle, non-ferrous metal, radiators, tires and rims, tractors and trucks. Future meetings were announced at the Hotel Morrison, Chicago, February 2, and at the Hotel New Southern, Columbus, O., February 10.

CALIFORNIA MUNICIPAL LEAGUE

At the meeting in Bakersfield, Cal., on December 16, of the San Joaquin Valley Municipalities Branch of the California Municipal League, Mayor W. F. Toomey of Fresno was elected president, Mayor Harry Hawley of Delano was elected vice-president, and Mayor Isaac Clark of Visalia was made secretary-treasurer.

AMERICAN ASSOCIATION OF ENGINEERS

A report just issued by the service department of the A. A. E. shows that it placed 3,243 engineers in positions during 1920. The lowest salary paid by any position filled was $125 a month; the highest $15,000 per annum. The average salary of positions filled was about $200 a month; and the total annual salary for all positions filled during the year about $8,500,000.

A resolution was adopted by the society approving the efforts of the state highway department toward the supervision of the construction of roads and its declaration of the necessity of engineers being employed in highway districts only after approval of the department.

The Arkansas Engineering Society, which, on January 17, voted unanimously to make application for a charter as a chapter of the A. A. E., has prepared an engineers' license law for introduction before the Arkansas legislature.

ASSOCIATED ENGINEERING SOCIETIES OF ST. LOUIS

The Engineers' Club of St. Louis, and the local sections of the A. S. C. E., A. S. M. E., A. I. E. E., A. I. M. M. E. and A. S. R. E. have united and formed the Associated Engineering Societies of St. Louis, modeled along the lines of the Federated American Engineering Societies. The society was given permanent form at the first meeting of the joint council, composed of two delegates from each of the member societies, held at the Engineers' Club of St. Louis on January 5. H. W. Eales, president of the Engineers' Club of St. Louis was elected president; and W. W. Horner, chief engineer, sewers and paving, St. Louis, was elected vice-president.

KENTUCKY ENGINEERS' CLUB

The Kentucky Engineers' Club was organized on December 20, and the following officers elected: President, C. W. Lovelle; vice-president, V. P. Ligon; secretary, W. M. Jarvis; and treasurer, W. O. Snyder.

THE ENGINEERS' CLUB OF PHILADELPHIA

On Friday, January 21, a "Symposium on Hydro-Electric Power and Distribution" will be held under the auspices of the Engineers' Club of Philadelphia and the Philadelphia sections of the American Society of Civil Engineers, the American Institute of Electrical Engineers, and the American Society of Mechanical Engineers.

Technical session at 2:45 p. m. and general session at 8 p. m., will be held in the auditorium of the Manufacturers' Club.

Informal dinner at 6:30 p. m. at the Bellevue-Stratford Hotel. Dinner tickets ($2.50) can be obtained at the Engineers' Club.

The program of the meeting includes:

"The Modern Hydraulic Turbine" (illustrated), by Frank H. Rogers, hydraulic engineer, I. P. Morris Department, the William Cramp & Sons Ship and Engine Building Company.

"The Application of a New Method of Water Measurement in the Efficiency Tests of the 37,500 h. p. Turbines of the Niagara Falls Power Company" (illustrated), by Norman R. Gibson, hydraulic engineer, the Niagara Falls Power Company, Niagara Falls, N. Y.

"Surges in Conduits and Other Hydraulic Problems" (illustrated), by Raymond D. Johnson, consulting engineer, New York City.

"The Present Trend of Hydraulic Turbine Development" (illustrated), by Lewis F. Moody, consulting engineer, I. P. Morris Department, the William Cramp & Sons Ship and Engine Building Company.

"Niagara Falls Power Development and Its Products in Philadelphia" (illustrated), by John L. Harper, vice-president and chief engineer, the Niagara Falls Power Company, Niagara Falls, N. Y.

Colored moving pictures covering power house equipment at Niagara, scenic views of upper rapids, the cataracts, Goat Island, etc., construction views of the new 100,000 h. p. extension and the erection of the world's largest hydro-electric units.

"Electrical Features of Hydro-Electric Power" (illustrated), by David B. Rushmore, chief engineer, Power and Mining Department, General Electric Company, Schenectady, N. Y.

KANSAS ENGINEERING SOCIETY

The thirteenth annual convention of the Kansas Engineering Society was held at Topeka, on December 16 and 17. The most important feature of the meeting was the appointment of a legislative committee to introduce in the Kansas legislature laws making the registration of engineers compulsory. The principal speakers at the meetings were Chancellor E. H. Lindley, of the University of Kansas, who spoke on "Human Engineering"; P. F. Walker, dean of the school of engineering, Kansas University; F. M. Veatch, who reported on sewage; H. S. McFadden, Topeka, on highways; D. L. Hammond, on masonry and concrete; W. E. Baldry and P. L. Brockway, on the use of paving materials; L. E. Conrad, on surveys; and C. A. Haskins, on water works. F. W. Epps, of the State Highway Department of Kansas, read a paper on "Bridge Development in Kansas." Plans for organizing a Kansas section of the American Society of Civil Engineers were begun by the members of the national society attending the state convention. A committee was appointed for this purpose. The new officers elected were: President, Dean P. F. Walker; vice-president, Lloyd B. Smith, Topeka; secretary, J. M. Averill, Topeka; members of the state engineering council, J. W. Mavity, Wellington, A. E. Noble and Norton; and Lloyd B. Smith, member of the American Engineering Council.

UTAH SOCIETY OF ENGINEERS

The Utah Society of Engineers at a recent meeting vigorously favored the development of arid lands, the use of flood waters and the further development of irrigation in Utah in general. The plan was outlined by A. F. Parker, chief engineer of the Utah Water Storage Association, in a draft of a bill which it is hoped will be brought in some form before the next Utah legislature. The bill would create a state development service, following the suggestion of the United States Reclamation Service.

NATIONAL CONFERENCE ON HIGHWAY TRAFFIC REGULATIONS

The delegates from thirty national and regional organizations at the National Conference on Highway Traffic Regulations, held in Washington on January 10-12, failed to agree in a specified form of uniform vehicle law presented by a drafting committee which met in Washington and prepared this law the net result of the meeting being the endorsement of "general principles," which were a practical duplication of the uniform law prepared last year by the Joint Committee on Uniform Vehicle Laws. It was soon found that the diverse interests represented could come to no agreement, so the committee on future activities recommended that the conference adopt only general principles for a uniform vehicle law, that no final vote on the proposed law be taken, and that the conference should adjourn with no provision for future meetings.

IOWA SOCIETY HOLDS SUCCESSFUL MEETING

The Iowa Engineering Society's 33d annual meeting which was held in Des Moines January 18, 19 and 20, was the most successful meeting in every way which the society has held. This meeting was attended by 327 engineers and 40 manufacturers' representatives. In addition to these, the wives of 45 engineers outside of Des Moines attended the convention and enjoyed the entertainment which was specially provided for them.

The technical program was carried out substantially as announced in PUBLIC WORKS, January 22.

The following officers were elected for the ensuing year: Professor John H. Dunlap, of Iowa City, president; Alvin Le Van, of Des Moines, vice-president; J. D. Wardle, of Cedar Rapids, director, and Lloyd A. Canfield, of Des Moines, secretary-treasurer.

WEST VIRGINIA ROAD BUILDING CONTRACTORS' ASSOCIATION

Road contractors from various sections of West Virginia and Ohio met in Wheeling on December 27 and formed the West Virginia Road Building Contractors' Association. The following temporary officers were elected: J. P. Mumaw, president, and T. J. Bartrue, secretary and treasurer.

ALBANY SOCIETY OF CIVIL ENGINEERS

At a meeting on December 21, the Albany Society of Civil Engineers elected the following officers: President, Alexander R. McKim; vice-president, Walter H. Mansfield; second vice-president, C. H. Wood; third vice-president, Joseph A. Murray, Jr.; secretary-treasurer, John W. Henry; and librarian, Carl O. Ullrich.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

SNOW LOADER MACHINE WITH CATERPILLAR TRACTION. SIDE PLATES REMOVED.

THE BARBER-GREENE SNOW LOADER

The new snow loading machine manufactured by the Barber-Greene Company, Aurora, Ill., is a powerful, self-propelling wagon loader type of apparatus designed to work continuously from end to end of a long windrow of snow turned up by plows and clear a 6-foot width of it as it advances, discharging from the elevated rear end to a succession of trucks driving under, receiving their loads, and passing on again to the dump without interruption.

It is 25½ feet long, 12 feet 4 inches high and weighs 10,000 pounds. It is mounted on crawler tractions with cast steel treads carrying chilled cast iron rollers, having a three-point suspension, the pivoted front axle, the rear axle secured to the upper frame at two points.

The rubber belt 32 inches wide and 22 feet long on centers has cleats 20 inches apart and is driven by a roller chain on each side. The snow plow has a straight up and down adjustment, scraping the pavement clean or elevating to clear obstacles. It will work in wet or dry, hard or soft snow.

It is driven by a 4-cylinder Buda gasoline engine, 3¾-inch bore and 5½-inch stroke. It is controlled by three levers and two hand wheels in easy reach of the operator, and has a speed of 40 feet per minute advance and 107 feet per minute reverse. The capacity is 3 cubic yards per minute and with it in a recent test at Chicago four or five men and four trucks did more work in the same time than fifty men and twelve trucks.

The machine is commended by the superintendent of streets, Chicago, who is using it for snow in winter and expects next summer to use it for loading ashes and gravel.

SPALDING 2-IN-1 ROAD MACHINE

The 2-in-1 road machine made by the Spalding Manufacturing Company is represented to save one-half the cost of handling dirt in the old way and is recommended as a great labor saver and money saver for contractors, road supervisors and road builders. It loads, hauls and spreads or dumps dirt for excavating, leveling, filling shallow places, drainage, irrigation ditching and dam building. A machine will load, haul and unload forty to sixty loads per day when operated by one man and a four-horse team, doing the work requiring four men and eight horses with scrapers.

It is claimed that it will load 1½ yards of unplowed dirt in 30 seconds and will handle sand, gravel, dirt or fine crushed stone. The machine is provided with an adjustable tilting cutting blade and two side blades that loosen the soil and deliver it to an inclined elevator that carries it up to a galvanized steel wagon box having a bottom composed of an endless distributing belt made up with transverse slats. The machine at rest is dumped by a foot lever and ratchet arrangement and is provided with a special steering device that enables it to turn in an 18-foot circle.

AUSTIN MODEL 6 EXCAVATOR

The Austin Machinery Co., in catalog No. 6, illustrates and describes an excavating machine mounted on caterpillar traction that, with different boom and bucket fittings, can be used as a drag-line excavator, as a steam shovel, as a railroad ditcher, or with a clam-shell bucket or a skimmer bucket, or as an ordinary locomotive crane or with a magnet hoist.

The principal features of construction include a turntable 5 feet in diameter, hoist drum 12¼ inches in diameter, boom suspension control operated by drum geared to main machinery, double-cone, spiral control, spring release drum clutches, 12-inch friction disks type inside band, swing clutches and a four-cylinder gasoline-type marine enclosed, heavy-duty engine with large fly wheels. The turntable and center are made in one piece, and multipedal traction is made with special pressed steel units with a combined area reducing the load on the ground to 5¾ pounds per square inch. The machine burns from 35 to 45 gallons of kerosene or distillate in ten hours and has traction speeds of ½ mile and of 1¼ miles per hour, drag-line or hoist-line speed of 110 feet per minute, single hitch, and swing speed of 3½ r. p. m., giving it a capacity of 300 to 600 cubic yards in ten hours with a ¾-yard bucket.

Used as a drag-line machine with a ½ or ¾-yard bucket and 30-foot boom, the average working speed is 1 to 3 buckets per minute and the shipping weight is 38,000 pounds. It is recommended for cleaning or enlarging old ditches or building levees, road grading and sewer excavations and for cutting trenches as small as 3-foot bottoms and 1:1 slopes.

Equipped as a steam shovel with a 6½-foot boom and a ¾-yard dipper, it is economical for all kinds of steam shovel work and has a long-handle dipper arm for the excavation of sewer trenches to a maximum depth of 14 feet. The rated capacity per hour for deep cuts is from 50 to 60 cubic yards and for shallow cuts from 25 to 35 cubic yards. The shipping weight is 35,500 pounds and the average working speed 1 to 3 dippers per minute.

When used as a railroad ditcher it is mounted on trucks with double flange rollers and can be used to advantage on a flat car or between two ballast cars. This equipment weighs 24,500 pounds and is suitable for use as a loading machine when the shovel and dipper arm are eliminated.

When equipped with a 30-foot trussed boom and a clam-shell bucket or an orange peel bucket it is efficiently operated by the two-drum control and is recommended for sewer work, gravel banks, dredging, excavating and general rehandling. It will handle coal, stone, gravel or sand at the rate of 400 to 600 cubic yards daily, and weighs 32,500 pounds.

When equipped with a skimmer bucket it will make a cut from a few inches to a foot in depth and 12 to 14 feet in width, leaving a smooth surface at any desired grade or slope and will load sand, gravel, clay and boulders up to 24 inches in diameter. It will take up and load broken asphalt pavement or any material that can be broken with a plow. It will grade from curb to curb of a 40-foot street.

ROAD CONSTRUCTION AND MAINTENANCE WITH WHITE TRUCKS

Under the above title the White Company, Cleveland, publishes a 16-page pamphlet printed on glazed paper and handsomely illustrated to show the value of the White dump trucks for

road building and maintenance, which will require a great amount of equipment for the 50,000 miles of road contemplated under Federal aid alone during the next few years.

A fleet of White trucks were used on the construction of many miles of government cantonments and military roads. Onondaga county, New York, maintains a fleet of nineteen road building White trucks and the Seiple & Wolff Construction Company, Youngstown, Ohio, which has done a great deal of road building, maintains a fleet of ten White trucks. The Gray Construction Company, road building contractors at Morristown, N. J., operates twelve White trucks which they report to be always dependable and economical to operate.

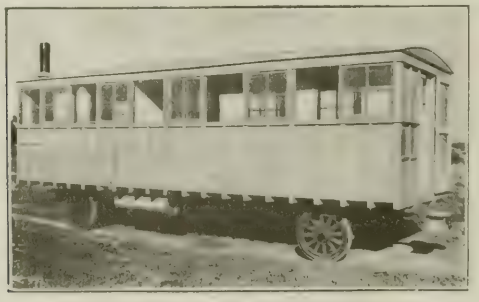
It is claimed that the operating records of White truck owners in the road constructing field show that they have lower fuel cost, are on the job more days and in the shop less days, and outlast trucks of all other makes and that they can be successfully operated under the hardest conditions doing the most work for the least money. The trucks are built of a ¾-ton light-service size, and on 2-ton, 3-ton, 3½-ton and 5-ton power dumping models.

BEST TRACK LAYER TRACTOR

The Best Sixty is a gasoline machine with caterpillar traction manufactured by the C. L. Best Gas Traction Company. The four-cylinder motor is of the valve-in-the-head type built for heavy duty. The caterpillar track is made with manganese steel spools and links and carbon steel cast shoes. They are 72 inches long and 20 inches wide and have dustproof bearings. All portions of the truck mechanism are accessible through inspection ports.

A NEW TRAILER DINING AND COOK CAR

A new dining and cook car manufactured by the Los Angeles Trailer Company, has a neat and compact design and is well built and carefully arranged to afford complete service for a movable camp, being easily hauled from place to place by an automobile, automobile truck or tractor. It was primarily designed for the use of the telephone company's field force, and has range and other complete culinary apparatus and storage provided in the rear, while the front part of the car is reserved for a dining room seating 14 persons.



DINING ROOM AND COOK CAR TRAILER

INDUSTRIAL NOTES

The Cutler-Hammer Manufacturing Co., of Milwaukee, has opened a branch office in the Railway Exchange building, St. Louis, Mo., of which Harold Phillips, recently manager of the Chicago office, will be in charge.

The Trojan Powder Co. has taken over the entire business heretofore conducted by it and its associated companies, the Pennsylvania Trojan Powder Co., the California Trojan Powder Co. and the Trojan Chemical Co., Inc.

The Chicago Pneumatic Tool Co. has appointed J. F. Huvane as eastern manager of compressor and engine sales with headquarters in New York City, and G. C. VandenBoom as western manager with headquarters in Chicago.

RAPID WORK OF AUSTIN PAVER

The 28-E Austin paver, the largest of all multi-pedal paving machines made, has established a record of completing 87 feet of concrete highway 18 feet wide in 40 minutes, equivalent to the rate of about 1 mile in five days, on a highway job in Pennsylvania.

ASPHALT PLANT EXHIBIT

The East Iron & Machine Company, Lima, Ohio, manufacturers of Merriman asphalt plants, will exhibit, at the American Road Builders' show at Chicago, February 9 to 12, a small model and will have a line of photographs to show and printed matter to hand out. The location, space 94, is close to the main entrance, and to the improved Merriman one-car railroad.

WARREN FOUNDRY & MACHINE CO.

M. L. Northrop, lately connected with the Pittsburgh Meter Company, has been appointed New England representative for the Warren Foundry & Machine Co., manufacturers of cast iron gas and water pipe, with offices at 201 Devonshire street, Boston, Mass.

NEW PIPE WAREHOUSE IN CHICAGO

The National Cast Iron Pipe Co. announces that immediately after February 1 their new warehouse plant at 37th street and South Ashland avenue, Chicago, will be in operation and will carry the largest and most complete stock of 3-inch to 24-inch cast iron pipe and specials to be found in the United States other than on the yards at a large foundry plant; also a complete line of valve and roadway boxes

PERSONALS

Young, James, has resigned as a member of the New Jersey State Highway Commission.

Takata, K., connected with the Public Works Department of Japan, is in this country studying our methods of road building.

Washington, W. O., formerly County Engineer of Caldwell County, Texas, has been appointed highway engineer of Cameron County, Texas.

Hildebrandt, John C., who for twelve years has been connected with the Philadelphia Trust Co., has been appointed comptroller of the Pennsylvania State Highway Department.

Hands, Stanley M., formerly City Engineer of Iowa City, Ia., has organized and is president of the River Products Co., a corporation which will produce and market building and paving materials.

Crockett, J. B., has resigned as county engineer of Collins county, Texas, to enter the contracting business.

Nicholson, Maury, has been appointed highway engineer for Mobile county, Ala.

Dilling, Albert W., has been appointed chief engineer of the Sanitary District of Chicago.

McDonough, Charles J., division engineer, New York State Highway Department, died recently in Buffalo.

Philips, Hector S., who before the war was in charge of the sewer drafting section of the department of works, Toronto, has been appointed engineer of sewer design, London, Ont.

Fish, Manus J., formerly superintendent of public buildings of Boston, Mass. died on December 14 at his home in Dorchester, Mass., at the age of 61.

Hastings, George B., city assessor of Guelph, Ont., has been recommended to the city council by a special committee of council for appointment as city manager, succeeding the late T. J. Moore.

Wynne-Roberts, L. W., is now resident engineer at Chatham for the Ontario Department of Public Highways.

Murdock, R. B., executive engineer, of the Asphalt Association, has resigned.

Carpenter, L. G., has been engaged by the San Diego, Cal., water commission to furnish plans and estimates for converting Dulzura creek into a conduit, which will convey the city water supply from Dulzura to Lower Otay.

Shilton, George S., for many years engineer in charge of the collecting system of the Brooklyn water works from East New York to Massapequa, died at his home in Rockville Centre, L. I., on January 17.

Morse, Charles J., formerly commissioner of water works and fire protection of Lowell, Mass., and previous to that, commissioner of streets and highways, died at his home on December 20, at the age of seventy years

Johnston, W. D., formerly city engineer of Waterloo, has been appointed engineer of Black Hawk county, Iowa

Foust, Samuel M., city engineer of Connellsville, Pa., died on January 5.

Pierce, Bradford D., for about twen-

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879

Vol. 50 FLORAL PARK, FEBRUARY 5, 1921 No. 6

Non-rigid Bases For Pavements

By Prevost Hubbard

In an article entitled "Flexible Pavement Bases" published in the January 29th issue of PUBLIC WORKS we gave extracts from and abstracts of parts of a paper presented before the Engineers' Club of Philadelphia a few weeks ago by Prevost Hubbard. This paper described some tests made by Mr. Hubbard on rigid and non-rigid bases, but only incidentally discussed the comparative advantages of the two. At our request Mr. Hubbard has prepared for this issue the following article in which he states briefly the advantages of asphaltic bases for pavements from his point of view. Mr. Hubbard was for several years chief of the Division of Road Material Tests and Research in the Office of Public Roads of the United States Department of Agriculture, and is the author of "Laboratory Manual of Bituminous Materials, for the Use of Students in Highway Engineering." Recently he has become associated with the Asphalt Association as chemical engineer.

There are two basic types of highway design, the rigid and the flexible. The first is represented by such pavements as Portland cement concrete and monolithic brick, and the second by the various bituminous pavements such as asphaltic concrete and sheet asphalt. There is also a composite or semi-rigid type represented by the Portland cement concrete base with a bituminous wearing course. A pavement of the fully flexible type has its base as well as its surface flexible, or is of one uniform flexible material throughout, as in the case of asphaltic concrete.

SHEET ASPHALT ON FLEXIBLE BASE IN VISALIA, CALIFORNIA

A 1-inch sheet asphalt surface on a 6-inch asphaltic concrete base, laid in 1894. The city engineer reported in 1920 that nothing had been spent for maintenance

ASPHALTIC CONCRETE BASE IN ALAMEDA
A 2-inch asphaltic concrete surface on a 3-inch asphaltic concrete base, laid in 1914. Present condition, excellent. Maintenance, none. The painted lines indicated parking spaces.

An asphalt base consists of mineral aggregate bound together with asphalt cement and forming a layer not less than 2½ inches thick. It should not be confused with asphalt binder, which is a relatively thin intermediate course placed between a sheet asphalt wearing course and a foundation proper, and is altogether omitted when an asphalt base is used, being then unnecessary.

There are two types of asphalt base known as asphalt macadam or the penetration type, and asphaltic concrete or the mixed type. The asphalt macadam base is constructed in much the same manner as an asphalt macadam pavement, but the seal coat and use of small stone to fill surface voids should be dispensed with, except that when a sheet asphalt or fine graded aggregate asphaltic concrete surface course is to be laid upon it, the small stone should be used on the top of the base. The base is usually laid in one or more courses, each varying from 2½ to 4 inches in thickness.

The mixed type of base consists of a coarse graded aggregate asphaltic concrete, laid and compacted while hot in one or more courses each 2 to 4 inches thick in exactly the same manner as the asphaltic concrete pavement. As it is neither necessary nor desirable to produce an extremely close surface, there is no need to use mineral filler in its preparation.

Bituminous bases have been laid for more than 40 years, and have given continuously satisfactory service for 20 years or more in Washington, D. C., Chicago, Omaha, Pittsburgh, Buffalo, Denver and other cities. More recently the use of the asphalt base has become more widespread, especially in the west. The state of Oregon contains nearly 7,000,000 square yards of asphaltic base and even more has been laid in California, where Sacramento has laid more than 300,000 square yards, Fresno more than 255,000, and several other cities have laid more than 100,000 each.

ADVANTAGES OF ASPHALT BASE

While a rigid type of foundation relies upon bridging action for support over small areas of compressible subgrade, the asphaltic base, because of its flexibility, maintains contact with the subgrade and thus utilizes its supporting value to the fullest extent. Under many conditions which would produce cracking in a rigid foundation, the slight yield of an asphalt foundation will maintain the pavement intact.

Experiments conducted by the Bureau of Public Roads (described in Public Works several months ago) have shown that impact from heavy traffic is one of the most destructive agencies to which modern highways are subjected. Any shock-absorbing element in a pavement reduces the destructive tendency of impact to both pavement and vehicles. An asphalt base is far more shock-absorbent than a rigid base, and in this respect possesses so decided an advantage over the latter that it may under many conditions be laid with safety to a less thickness than would be required for a rigid base.

Where the wearing course is of asphalt, the asphalt base offers additional advantages. There is a firm bond between wearing course and base, since the asphaltic base and asphaltic top knit together to produce an integral structure and materially reduce all tendency of the wearing course to shove under traffic at the point of contact between base and wearing course.

In the rigid type of base there exists the same

FLEXIBLE BASE ON STREET WITH TRACKS IN SACRAMENTO
A 1-½inch asphaltic concrete surface on a 3½-inch asphaltic concrete base, laid in 1915. Present condition, excellent; cost for maintenance, none.

inherent tendency to crack as in the rigid type of road, and when such cracks form they are more than apt to be carried through the asphalt wearing course, while there is little tendency for an asphalt top to crack when laid on a flexible base.

Because a rigid base is not shock-absorbent, it acts as an anvil upon which the asphalt wearing course is subjected to a much more severe strain from the impact of traffic than is the case where the base itself is shock-absorbent in character.

Asphalt is used extensively in the water-proofing and roofing industries and a dense asphaltic concrete base with asphaltic wearing course produces a structure water-proof throughout and one therefore not subjected to internal stress due to absorption of water or to distintegration by frost action. On the other hand, the usual Portland cement concrete base is not water-proof but actually absorbs moisture from the subgrade by capillarity, which moisture tends to expand the concrete and subject it to internal stress. It also frequently maintains a film of moisture between it and the asphalt wearing course which is a source of weakness and may greatly accelerate disintegration.

An asphaltic base permits of several economies in construction. No type of foundation can be adapted more readily to the utilization of available local material. When laid in conjunction with an asphalt top it requires only one organization and equipment to be maintained by the contractor, while, as stated by a prominent contractor, "Cement concrete requires additional equipment and a different organization and the work is necessarily slower in progress."

Where asphalt base is used, the pavement is ready to receive the wearing course immediately, and entire sections of the pavement may be laid and opened to traffic within a period of 24 hours; while a pavement of concrete or with a concrete base should be closed to traffic for at least 10 days. This is often an important consideration in both original construction and repairs.

The maintenance cost on asphalt pavements has been as a rule exceedingly low. Examples can be cited of such bases which have given 10 to 20 years' service with no maintenance, notwithstanding an increase in volume and weight of traffic which could not be forseen when the pavements were constructed. In 1894 the city of Visalia, Cal., constructed three blocks of asphalt base pavement on Main Street, this being a 6-inch base with a 1-inch sheet asphalt wearing course. In June, 1920, city engineer L. H. Gadsby reported that "Nothing has been expended for maintenance on this pavement and it is in excellent condition today. We have no doubt that this pavement is good for many future years of service in spite of the tremendous increase of traffic in volume and especially in weight." The same city built 10 years ago a 4-inch asphaltic concrete base without any wearing course, which has successfully carried heavy traffic from trucks and trailers piled high with fruit. In 1916 Kings County, Cal., constructed approximately 103 miles of asphaltic concrete pavement consisting of 7½ inch base and 1½ inch wearing course. The traffic is considered heavy, trucks weighing 10 to 14 tons traversing certain sections, but after 4 years of service all but one mile was in excellent condition and County Engineer Roy Maye reported last year a total expenditure for maintenance of this pavement of but $1,599.78, most of which expense had been incurred on one mile over a stretch of poor foundation.

THE ILLINOIS STANDARD

In certain localities an attempt has been made to standardize the design of all pavements for heavy traffic upon the basis of a rigid slab or beam because of its bridging value. Such pavements have been adopted as standard by Illinois, Clifford Older, chief highway engineer of that state, stating that "A standard concrete slab 7 inches thick at the side and 8 inches at the center for 16 to 18-foot widths has . . . been adopted by the state of Illinois as the basis for all its rigid surfacng." He admitted that it was a matter of opinion as to how much weight could be given to the transverse strength and cushioning effect of a bituminous wearing course and dismissed the subject by stating that "It has been decided for the sake of simplicity to allow the equivalent of 1 inch of concrete for both the 2-inch and 3-inch wearing surface."

This would require a base 7 inches thick at the center for sheet asphalt or other bituminous wearing surfaces, which is one inch thicker than the bases that for years have given satisfactory service in hundreds of cities. In addition, he requires a mixture of 1:2:3½ concrete, while 1:3:6 concrete has been in common and satisfactory use for city traffic for many years.

In certain quarters Mr. Older's conclusions have been accepted apparently without question, but the long service history and present condition under

ASPHALTIC CONCRETE ON NON-RIGID BASE IN HAYWARD, CALIFORNIA

Constructed in 1908, with 1½-inch asphaltic concrete surface on 3-inch asphaltic concrete base. The present condition is good, although nothing has been spent for maintenance.

heavy traffic of 6-inch 1:3:6 Portland cement concrete base, with a wearing course of 2 to 3 inches of asphaltic concrete or sheet asphalt, at least make these conclusions questionable if they do not absolutely disprove them.

ABSOLUTE RIGIDITY SELDOM NECESSARY—NEVER DESIRABLE

While the rigid type of foundation has certain valuable characteristics inherent to its rigidity, it also possesses some objectionable features which do not occur in the flexble type of foundaton. The service history of old macadam and telford roads which have been successfully utilized as foundations for asphalt pavements is positive proof that absolute rigidity in the foundation is not essential, provided adequate support is furnished by the subgrade. While the stability of a newly constructed broken stone foundation seldom if ever equals that of an old consolidated broken stone road, the use of asphalt in its construction will produce an even greater degree of stability, as is well known.

No practicable design of highway permits the assumption of more than a temporary bridging action over appreciable areas of a weak subgrade. In fact, it is now generally admitted that very careful preparation of the subgrade is necessary to uniformly support the all-rigid types of pavement. With some amount of care in subgrade preparation there is probably less chance of a failure in a partly flexible foundation. The failure of a rigid base to successfully bridge over large areas of poor foundation, even when covered with an asphaltic wearing course, was illustrated by the utter destruction of such a pavement over a sub-base weakened by frost action which was described in Public Works for August 14, 1920. (See page 134.)

The importance of impact in the destruction of highways has been referred to. In order to compare the relative resistance of rigid concrete base and asphaltic base, experiments under impact are being conducted by the writer. Some of these tests were described in a paper which was presented in abstract in the January 29th issue of Public Works. It will therefore suffice simply to state in this article that, while the tests have not yet been carried to the point where definite comparisons can be made on all designs and types, a sufficient number of results have been secured to indicate general tendencies. These show the following: (1) Compressed asphaltic paving mixtures developed very decided slab strength as measured by their resistance to impact; (2) in the semi-rigid type of construction the asphaltic wearing course greatly increases the resistance of the structure to impact.

IMPORTANCE OF SUBGRADE

The asphalt base has proved much more popular in the west than it has so far in the east, but it is believed that, once given a fair trial in localities where it has not yet been used, its general adoption for many highways which would otherwise be constructed with a more expensive rigid base will follow. Conditions in California were especially favorable to this kind of base in that the soil and climatic conditions produced natural subgrades with high supporting value. Similarly favorable conditions can be obtained in other localities by proper drainage, compaction and in some cases special preparation and modifications of the existing subgrade. Such favorable condition of subgrade having been obtained, there can be no question that flexible bases will prove as satisfactory elsewhere as they have been for many years on the Pacific Coast, where relatively thin asphaltic pavements have for years successfully withstood the punishments of a heavy traffic, while under the same conditions the rigid type of pavement has been badly injured or destroyed. In many cases it will cost less to drain and otherwise improve the subgrade than to provide the additional thickness of base required, whether this be of a rigid or non-rigid type; and given a good subgrade, the flexible base may be expected to repeat anywhere the success which it has had in the western states.

Much can be done toward keeping a subgrade dry by proper drainage, but some soils are so persistently retentive of moisture once absorbed that it is impossible to remove it with sufficient rapidity by any ordinary system of drains. Such a subgrade may frequently be greatly improved at relatively low cost by mixing sand with it, forming a sand-clay road. Such a mixture will retain less moisture than clay and when moist will possess a much higher supporting value than moist clay. Similarly, sands which are unstable when dry may have their supporting value increased by thoroughly mixing clay with them. Other soils of light, pulverant character which fail to compact satisfactorily may be hardened by a dressing of gravel, slag or broken stone. In other cases it may be necessary to distribute the load over a larger area by laying a subbase course of gravel, slag or broken stone. Western states and cities have found a 4-inch compacted sub-base adequate to care for heavy traffic in trunk line routes. An old macadam, telford or gravel road makes an excellent sub-base when it is available.

The above suggestions for the improvement of sub-base are given merely to indicate that it is practicable and frequently inexpensive to produce a subbase as favorable to a flexible base pavement as is the soil naturally found in the far west where the greatest experience and success have been had with this type of base.

FOR NON-BITUMINOUS WEARING COURSES

In conclusion, it may be suggested that the asphalt base is desirable not only for bituminous wearing surfaces, but also for brick and block pavements. A Portland cement grout filler in either brick or block construction produces a rigid pavement which requires a rigid base to maintain its integrity. The National Paving Brick Manufacturers' Association, although a few years ago greatly in favor of the cement grout filler, has during the past year or two recommended the bituminous filler. Asphalt filler for both brick and stone block has among its advantages the prevention of cracks caused by temperature changes, ease of repair, and accessibility to traffic immediately after construction instead of keeping the pavement closed for a week or ten days as is necessary if a grout filler is used. With a bituminous filler, a block pavement of any kind—brick, stone or wood—can secure many of the advantages of a flexible pavement by being placed upon a flexible base.

Absolute rigidity is seldom necessary and is never a desirable characteristic in a pavement structure.

The Illinois Experimental Highway

By Prof. Chas. Carroll Brown*

Of the several groups of pavements constructed to test or demonstrate the effect of variations in paving materials or construction that have been installed and tested during the past few years, that now under construction by the Illinois Division of Highways possesses several unusual features which are worthy of note.

This stretch of two miles can be built and the test completed without its having to carry any regular traffic, after which it will become a regular traffic highway. The sub-grade and other natural conditions throughout the entire route are as nearly uniform in all particulars as could be obtained. Although there are 64 sections, only a few varieties of materials are being tested—in fact, the entire test appears to be chiefly one of concrete as a complete pavement and as a base for brick and asphaltic surfaces, and to be made to determine the best method of constructing concrete pavements and bases.

This description has been written after a personal examination in combination with a collection of official data, by one who needs no introduction to the readers of engineering periodicals.

A test road is being constructed by the Illinois Division of Highways for the purpose of conducting experiments upon concrete roads, and concrete bases with brick and asphaltic concrete wearing surfaces, each constructed with variations in thickness, reinforcement, treatment of wearing surface, etc., so as to add definite information and data to the theoretical and practical knowledge of the wear and failure of highways. The ideas entertained by Clifford Older, the chief engineer of the Illinois Division of Highways, and adopted as a basis for the specifications of the highways of that state are generally known, and presumably a considerable part of these tests will be devoted to trying out certain of Mr. Older's theories, which will be described later on in this article.

GENERAL DESCRIPTION OF ROAD

The pavement is divided into sections 100, 150 or 200 feet long, about 40 per cent of them being concrete pavement and the others being brick pavement with bituminous and grout filler, and asphaltic concrete pavement, both on concrete base, except for eleven sections of brick and asphaltic concrete which are on a macadam base. It is unfortunate that the department has not recognized the great importance and value of bituminous-bound foundations for pavements for such unfavorable conditions as are bound to be found in the subgrade of this test road and that none of the sections have been laid with such foundations. It is not often that conditions so uniform in all respects are found as there are in this length of pavement, especially when the location of the road is considered and the consequent possibility of keeping general traffic off until the traffic test has been completed.

The road runs approximately east and west, paralleling the Wabash railway on the south, about 14 miles west of Springfield. The entire test road is on a new location intended ultimately to replace another road several feet away. Only one existing road is crossed by the experimental road, and this crossing will be paved with 50 feet of standard 8-inch concrete pavement. It will be possible, therefore, to construct the road, test it, and repair or reconstruct any section that may require it, before turning the regular traffic over it.

The conditions as to grade, drainage, character of soil in subgrade, and stability of the same are as nearly uniform as could be secured in any two miles of road. The sub-soil throughout is of brown silt loam—the common clayey soil of the Illinois prairies. Owing to almost entire lack of surface drainage there are considerable areas where it has the appearance of black swamp soil and approximates the waxy characteristics of the soil called gumbo. The grades are undulating, varying from zero for 100 or 200 feet at summits or bottoms of grades to a maximum of 0.4 per cent for even shorter distances, the grades averaging 0.1 per cent. Concrete box culverts are placed at the bottom of each of the two principal synclines, which connect side ditches, but as there seems to be no outlet for these ditches the culverts simply equalize the water level on the two sides of the road. The railroad cuts off surface drainage from the north, while on the south the land slopes partly toward the road and partly from it. Drainage ditches of the road that crosses the test road and those of the two roads at the ends of the test road will probably remove some of the water from these ditches. It is probable, however, that after heavy rains water will stand in the side ditches of the test road for considerable distances until it evaporates or soaks into the comparatively impervious sub-soil. It was intended to test the effect of sub-soil drainage upon the moisture in the subgrade, but difficulty of securing an outlet for the drains prevents this. There are many square miles of Illinois area that approximate more or less closely to these conditions, which are about as unfavorable to road maintenance as could be found, and a pavement that will stand

*Professor of Civil Engineering, Valparaiso University.

traffic on this test road under its worst conditions will stand the same traffic on any road in the state.

After the road has been constructed it is proposed to subject it to artificial truck traffic, gradually increasing the weight of this until it exceeds by about 50 per cent the road limit set by the Illinois highway regulations. It would seem advisable to continue such tests through periods when the subgrade will have its lowest value for supporting paving traffic, that is, when the moisture in the soil is at a maximum. Any differences in the amounts of moisture in the subgrade during the testing periods might easily make material difference in the effects of the loads upon the pavement slabs of the various materials, and mention should be made of any such difference in the bulletin which Mr. Older promises descriptive of the details of the design and construction, plan of loading, and apparatus for and methods of observation.

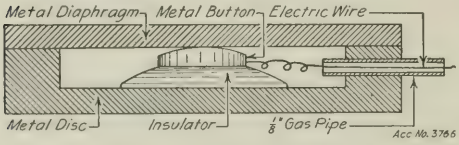
The road is to be built directly by the division of highways, using state equipment and labor employed for this job. E. M. Fleming, acting road engineer, is the engineer in direct charge of construction and is to be highly commended for the careful way in which the details are being carried out. The question of variations in methods of construction is practically eliminated, at least so far as the work already constructed is concerned. It is to be hoped that the winter intermission will not change conditions enough to introduce any uncertainties of this kind.

In the construction of the concrete pavements and bases, Heltzel steel forms were used and, for the concrete pavements, the Parrish road tamper and finisher. The proportions and mix for the different sections of concrete will be described in detail later on.

TESTS TO BE MADE

Pressure cells such as are used by the United States Bureau of Public Roads have been inserted at regular intervals along each edge, the center, and in some places at the quarters of the road, by which the behavior of the subgrade before and during loading can be observed. Special observation pipes have been set on each 25 feet of the length of the road. At each section one observation pipe is set 18 inches from each edge of the pavement and another is set at the center, while in some places additional pipes have been set midway between the sides and the center. At the bottom of each pipe a loose brass disk lies on the subgrade. By means of an inner pipe the disk is forced down when a load deflects the pavement. An Ames dial is used to measure to permanent or temporary depression of the subgrade. The supporting power of the soil may be measured independently by loading the disk. By removing the disk, samples of the sub-soil can be taken as desired in order to determine their moisture content or other characteristics. The top of the outer pipe is flush with the top surface of the concrete and is closed with a plug to keep out the water and dirt, which plug is easily removed.

Observations of the sub-soil action should give data of great value, and the relations of compressibility and moisture content, of load and compression, and possibly of swelling and moisture, will have light thrown upon them proportional to the extent of the observations and the care with which they are made.



GOLDBECK EARTH PRESSURE CELL

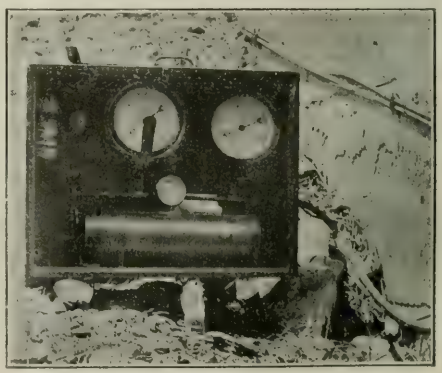
The cell is a hollow metallic disk, one face of which (top face above) is an elastic metal diaphragm. The cell is buried in the earth under the pavement. The earth pressure keeps the diaphragm pressed against the rounded surface of the metal button, thus closing an electric circuit carried by wires to the top of the dam through a small air pipe, as shown. When a measurement is to be made, air is admitted into the hollow of the cell from a compressed air tank, thus balancing the earth pressure, till, just at equilibrium, the diaphragm is forced outward, breaking the electrical contact with the button. The break is indicated by the going out of a small electric indicator lamp in the circuit. The pressure is then read on an air gage connected with the air pipe line.

THE ILLINOIS THEORY OF PAVEMENTS

In a paper by Chief Engineer Older before the recent meeting of the Association of State Highway Officials, he developed the present tentative method of design of rigid pavements used in his department, and gave the reasons therefore so far as they have been definitely determined. He assumes as demonstrated that wear of the surface of rigid pavements on well-constructed rural highways is a negligable factor and that internal stresses due to the expansion of the pavement can be resisted by the pavement material. He acknowledges that no method has yet been devised for preventing the cracks that occur in rigid pavements, but states that if they are properly cared for they affect the rigid slabs between cracks and joints only as they may affect its strength or load-carrying capacity,

The thesis of his paper was the determination of the characteristics of a design which will give slabs or fractions of slabs sufficient strength to carry the loads to which they will be subjected.

He assumes as a demonstrated fact that a concentrated load on the slab at or near its center will have much less effect than one on an edge of the slab, and that one at the intersection of edges, joints or



PRESSURE RECORDING APPARATUS

At right is seen pipe leading to pressure cell

cracks, that is, at a corner of a slab or fraction thereof, will have the greatest effect in breaking the slab. It is therefore necessary to so design the entire slab that the corner will carry the imposed loads.

Some investigations by the Illinois division of highways as well as experiments by the United States Bureau of Public Roads show that clay soils have their supporting capacity greatly reduced in some proportion to the amount of moisture contained in the clay. Much of the soil of the Illinois corn belt is clay that absorbs moisture rapidly and, under the very generally existing conditions of rainfall and lack of drainage, may have its supporting capacity near the surface reduced almost to zero for a considerable part of the year. Under what may be considered ordinary conditions this lack of support to power may be observed quite frequently. Mr. Older cited an 18-foot pavement laid on a subgrade on which no rain had fallen for 6 weeks, which subgrade, when the pavement was about a month old and following two days of drizzly rain, was found to contain about 17 per cent of moisture under the center of the slab.

He considers it proper, therefore, to assume, for the purpose of making the corners of the slab as strong as the center, that the supporting power of the clay under a corner is or may be zero. The design of the entire slab depends therefore on the design of the corners.

Another assumption is that no economical use of reinforcing steel has yet been devised.

It is proposed to omit bituminous filled expansion joints and to use instead frequent dividing planes with dowel pins or tongue-and-groove joints, so that the erractic transverse cracks may be expected not to open materially. Such a joint has been formed in the experimental pavement by using a strip of horizontally corrugated galvanized metal set in the vertical joint between sections. The same sort of joint is used longitudinally down the center of some of the sections of the experimental pavement.

It is believed that with this sort of a joint a wheel load placed on one side of a joint or crack near a corner may be considered as divided equally between the adjacent corners. With bituminous filled expansion joints or infrequent contraction joints or dividing planes, the wheel load must all be considered as being carried by one corner, according to Mr. Older.

Observations of vibrations in slabs and especially at corners with loads passing near, indicate that the effect of impact may be considered as offset by subgrade support, and improbability of the maximum wheel load ever being applied at the point causing maximum movement.

With a given load at a slab corner, the natural tendency would be for the slab, acting as a beam supported at one end and free at the other, to bend downward, setting up a tensile stress in the upper part of a cross section taken at an angle of 45 per cent with the two edges of the slab that meet at this corner. The perpendicular distance from the corner to this critical section is unknown, but the length of the critical cross section is twice the perpendicular described. Using the standard formula for the depth of slab in terms of moment of inertia, the unknown disappears in the reduction and the value of the depth of the slab is found to be the square root of the quotient obtained by dividing three times the load on the corner by the allowable tensile stress of the material in the upper part of the slab. If the load is assumed to be divided between two adjacent slabs, the quantity under the radical will be divided by two. In other words, the depth of the slab will be the same throughout, and independent of the distances of the section from the load.

Mr. Older does not consider the shear set up in the slab by the load, but a few moments' consideration will show that it is of importance for only a short distance from the corner and that the load as ordinarily applied to the corner through the bearing of the tire on the slab will probably more than cover the critical section on account of shear.

Instances were cited of breaks made at corners which confirm the judgment exhibited in the above assumption and deductions therefrom. The fiber stress in the concrete will be shown by computation to be about 750 pounds per square inch but is undoubtedly less at or near the corner for the reasons just given. The modulus of rupture of the concrete in one example cited was probably between 500 and 600 pounds per square inch. Only 12 corners were broken out of several hundred in the case under consideration, indicating that the maximum computed stress is seldom or never reached and the ultimate strength of the concrete was seldom reached; owing partly to support to some extent by the subgrade, partly to mutual support of adjacent corners, and to the fact that the truck loads only approach the corners when two trucks turned out to pass each other. Only about 1,500 loads of stone were hauled during the period of investigation, the other loads being negligible in number and weight.

Said Mr. Older: "The further investigation of slab deflections and stresses, the effect of mix, type of wearing surface, etc., on modulus of rupture, the supporting capacity of soils with varying moisture content, the variation of the moisture content and supporting capacity of such soils under pavement slabs at different seasons and with different types of drainage systems, the compression of soils under repeated loads, the possibility of largely controlling the location of longitudinal and transverse cracks by sheet-metal divisions, the mutual support of adjacent slabs afforded by friction of the rough surfaces at cracks, the mutual support of adjacent slabs which may be secured by artificial means at dividing planes, and other items affecting the transverse supporting capacity of pavement slabs is being carried on in connection with a two-mile test road being constructed by the Illinois Highway Department, and at favorable points on old pavements."

By permission of Mr. Older and in company with F. M. Fleming, acting road engineer, who has been in direct charge of the construction of the experimental road on the ground, an inspection of the road was made very recently by the writer. From the data furnished by Mr. Older's permission and found in his paper above referred to, and from observations made personally, the preceding general

description of the road has been prepared and the more detailed description given below. The department will, at a later date, publish detailed accounts of the design, construction and testing of this road. The writer is greatly indebted to the engineers named and to Frank T. Sheets, engineer of design, for furnishing these data and facilities for inspecting the road.

(A detailed description of the methods of constructing the various sections of the test road will be given in a subsequent issue.)

Street Paving in Goldsboro

By W. A. Hardenbergh

Four three-bag batches carried in each five-ton truck. Twenty-two men lay one thousand square yards of concrete base a day.

A short time ago PUBLIC WORKS described a concrete road job in North Carolina where Ford trucks carried one-batch loads to the mixer. In a large street paving contract in Goldsboro, N. C., 5-ton trucks are used to carry four three-bag batches to the mixer engaged in laying the concrete base 5 inches thick. The wearing surface is to be asphalt, and the job involves the laying of about 60,000 square yards of 1½-inch binder and 1½-inch wearing course. All the work is within the city limits. The West Construction Co., of Chattanooga, Tenn., is the contractor, and the J. L. Ludlow Co. are engineers for the city.

The work throughout is typical of present-day construction where man economy prevails. (In this connection it is interesting to note that labor conditions are far different now than when the work was started. Men who, as common laborers, were getting $4 per day early in the fall, are now drawing $2.50 and there are possibilities of another cut.) The equipment on the job, which is being pushed forward rapidly, includes a grading scraper, three 5-ton motor trucks, a paving mixer, a crane for handling and unloading aggregate, an asphalt mixing plant, a roller and some horse-drawn trucks. These latter are being used in hauling the asphalt.

Inasmuch as most of the streets are already fairly well to grade, not much grading was necessary. Hand grading, with the occasional use of scrapers and scraping graders, was the rule. Most of the soil is a kind of sandy loam, which handles well, but clay occurs in the lower sections.

Following grading, the street is rolled and the concrete base is laid. This is in accordance with the usual North Carolina state practice, the base being 5 inches thick, of a 1:3:5 mix. Multi-Foote paving mixer (caterpillar tread) is used, turning out three-bag batches. The rate of progress has been very satisfactory, and in places where continuous work is possible, 50 to 60 truck-loads of aggregate are used per day. Each truck-load contains 4 three-bag batches, which means that as much as 1,000 square yards of base are laid in a day under best conditions.

The mixer gang is small. It is composed of the engineer, the fireman, two sub-grade men, three concrete spreaders, and two finishers, a total of nine men. Aggregate, with the cement dumped on top, is brought, as already stated, in motor trucks and the ready proportioned batches are dumped into the mixer scoop.

Three motor trucks are used, all 5-ton. Two are Macks, which are owned by the contractor, and the other is a Federal, which is rented by the hour, as needed. All have power dump and metal bodies, which are divided by hinged metal partitions into four compartments, each compartment being large enough to contain one batch. The truck is backed up to the mixer scoop, the body raised to dumping position, and the gate to the rear compartment loosened. This allows the first batch to slide into the scoop. The truck is then moved forward about a foot so that the mixer scoop can be raised. After the mixer has been charged and the scoop again lowered, the truck is once more backed into position for dumping and the next partition raised, allowing the second compartment to be dumped. This process is repeated, the truck moving forward and backward, until all four compartments have been emptied.

It will be noted that two men at the mixer are assigned to sub-grade work. The trucks are all equipped with solid tires, the Macks having dual rear tires. All of the trucks when loaded cut rather deeply into the subgrade, and the two men are kept busy repairing these cuts, filling, spreading gravel where needed, etc. Smaller trucks, of two or three tons, with pneumatic tires would be a real improvement from this point of view, for even with the precautions observed, some troubles have been encountered where the soil is not well drained, or where the subgrade is soft.

The trucks are loaded with sand, stone and cement at stock piles. An Erie crane, equipped with a 21-foot clam-shell bucket handles the aggregate, unloads cars, etc. Each of the four compartments on every truck is marked to indicate the height to which it is to be filled with stone, it is then filled level full with sand. On top is emptied three bags (for each comparment) of Portland cement. Four men, who assist in leveling the loads and in getting the right amount of sand and stone in each compartment, a foreman and checker, the fireman and the crane engineer are assigned to this work, with two additional men to handle the cement.

Sixty truck-loads is assumed as the proper amount of work for a ten-hour day. This allows about ten minutes for filling, loading, getting cement, and getting out. As a matter of fact usually half this time is sufficient, but the three trucks are now working the mixer at capacity. The crane also is used to unload sand and stone, which are shipped in. If allowed to work uninterrupted, twenty to thirty minutes are sufficient to unload the average car. Large stock-piles are maintained.

This arrangement shows nine men and a foreman at the mixer, eight men and a foreman at the stock-piles, and three truck drivers as the entire mixing, hauling, and laying gang.

The laying of the sheet asphalt has been started only recently. The "hot-stuff" is being hauled in

horse-drawn trucks, as all hauls are short, most of them being less than half a mile.

The asphalt plant used is one manufactured by the One-Fire Asphalt Plant Co., of Chattanooga, Tenn. As its name indicates, the plant operates with only one fire for power, drying, heating, etc. This plant was described recently in PUBLIC WORKS.

The binder course is composed of 75 per cent stone and 25 per cent sand, with about 7½ per cent of Texas asphaltic cement. The surfacing mixture is composed of 30 per cent to 35 per cent of material passing an 80 screen, 50 per cent passing a 40 screen and the balance a 10 screen. The asphaltic cement content is about 10½ to 11 per cent.

Reinforcing Concrete Pavement

The function of reinforcing is described by H. Eltinge Breed as to "preserve the integrity of the pavement and prolong its life." It lessens cracking and renders less injurious the cracks that occur. It also takes stress and lessens fatigue.

The use of reinforcement in concrete pavements has been increasing for several years past. Of the pavements laid during 1920 in several hundred cities as reported to PUBLIC WORKS in January, 1921, about 35 per cent of the concrete pavements included were furnished with reinforcement, some details of which are given elsewhere in this issue.

The function of steel reinforcement is described in a recent discussion by H. Eltinge Breed, consulting highway engineer, as being to "preserve the integrity of the pavement and prolong its life." The following extracts and abstracts from Mr. Breed's discussion give his reasons for advocating reinforcing.

"Steel reinforcing in concrete pavement tends to lessen cracking in the pavement, to render more innocuous those cracks that occur, to prolong the life of the pavement by relieving the fatigue due to tensile stresses, and to justify its cost by increasing the service of the road, decreasing its maintenance, sometimes offsetting the necessity for additional depth of concrete."

CRACKS IN PAVEMENT

"The defect of the concrete pavement today is the cracks that appear upon its surface. If we can prevent those, we shall increase greatly the desirability of the concrete road. . . . Cracks weaken the integrity of the pavement in which they appear, and in the effort toward improvement, we want to eliminate them."

"While only a few cracks appear during the first year after a pavement is built, more develop during the second, and still more during the third, unless the pavement is reinforced. Of the truth of this statement, New York State Highway No. 5,314 is a good example. It was built in 1914 and a crack survey of it was made in April, 1915, 1916 and 1917. In two representative miles there were 1,479 linear feet of cracks in 1915; 3,210 in 1916; and 6,116 in 1917. . . . Five hundred miles of concrete pavement were laid in New York State up to 1919. Seventy-five miles had reinforcement varying from 22 to 25 pounds and from 22 to 30 pounds in weight. In some cases this weight of metal was doubled over bad soil conditions. The sections reinforced are in better condition today, under the same condition of soil, aggregates, etc., than the plain sections are. It is noticeable that with an increased amount of metal there is a decrease in the number of cracks and a much better condition of the paving surface, i.e., freedom from cracks, spalling, etc."

"Cracks are due, as far as we know, to these causes; poor workmanship or poor materials, either of which is intolerable; contraction due to variations in temperature and moisture content; settlement of the subgrade; overloading and impact. Settlement is caused by frost action, by consolidation of the subgrade and by volume changes in the subgrade.

"The first of these causes we can and must prevent; the others we must offset. The most effective means of offsetting them that we have yet discovered is, I believe, the use of steel reinforcement.

"The longitudinal crack is the more serious because, being along the axis of the road, it may catch the wheels of traffic like a track and carry them along its length. The traffic, of course, chips off and wears down the edges and a gash results, which requires maintenance.

"Transverse cracks tend to develop unevenness, one side becoming depressed. Traffic bumps over the ridge, and the resulting impact crumbles the edges and starts spalling."

TENSILE STRESSES

Mr. Breed quotes the familiar impact tests of the Bureau of Roads, showing that a truck may impose an impact of 20,000 pounds if falling from a height of ¼ inch, which may amount to 43,000 pounds if the fall be 3 inches.

"To build roads to withstand such impact as this last would be financially ruinous. What we can and must do is to build roads of such smoothness that there will be no intensification of the impact pressure." Wear due to accidental cracking may be eliminated by using every known precaution to prevent cracking, and, when it does occur, by holding both sides level so as to minimize impact. "To

hold the edges level and prevent the spreading of cracks where they appear is one function of steel reinforcement."

Mr. Breed believes that "impairment of a concrete pavement is due not so much to immediate shocks from above as to cumulative fatigue generated by intermittent tensile stresses. Another function of steel reinforcement is to take these stresses, lessen fatigue and thereby prolong the life of the pavement." That it serves this purpose has not yet been proved by definite, indisputable scientific data, but Mr. Breed believes that it is indicated by observations of roads in actual service.

"If a highway slab were reinforced heavily enough to take its loading in the same manner as the slab design of a building, the cost would be excessive. This is not necessary. In building work, failure is often disastrous, but on a highway it may be cheaper to allow one slab to fail and be rebuilt adequately to the poorer foundation, than uniformly to reinforce the whole roadway in accordance with the worst condition found. . . . "The analogy between the use of steel reinforcing for structural work and for highways will not hold, but the writer believes that steel will be a factor in helping us build better roads. With the proper use of the right amount of reinforcing steel, pavements can be built to withstand the increased traffic that will be put upon them."

AMOUNT OF REINFORCEMENT

Apparently no formula or definite theory has been developed for calculating the scientifically correct amount of reinforcement to place in a road. "On account of the fact that transverse cracks are not as dangerous as longitudinal cracks and as the latter are the ones to be eliminated if possible on account of the destructive effect of traffic running along them, it would seem wise to take a metal that has a ratio of from 1 lengthwise to from 3½ to 5 across the pavement. Many of the standard styles made now have about this ratio and the writer believes it gives the best results. In city work, however, where transverse cracks are more detrimental, the ratio should be from 2½ to 1 crosswise to 1 lengthwise, depending on the length of the slab."

Mr. Breed, at the time of writing this discussion, was constructing at Bennington, Vt., a city pavement in which he was using 40 pounds of metal per hundred square feet on narrow sections on either side of a car track, the concrete being 6 inches deep and the slabs 8 to 9 feet wide, the traffic being medium to light. On the main street of the same city he was using 75 pounds of reinforcement in two layers, 40 pounds to the lower and 35 pounds to the upper, with a width of slab of 14 to 18 feet. Most of this pavement is on a coarse gravel and sand foundation.

In the latest revision of the standard specifications of the American Society for Municipal Improvements which have recently been submitted to letter ballot for adoption by the society, it is recommended that for pavements 20 feet or less in width the reinforcement should be steel fabric of not less than 30 pounds per hundred square feet with the effective area across the pavement four times that along the axis of the pavement and with the spacing of the main members of the fabric between 4 and 6 inches. Where the pavements are wider than 20 feet the weight of reinforcement should be increased one pound for each foot of width of pavement up to 50 feet. It is recommended that the reinforcement be placed two inches below the surface of the pavement and extend to within two inches of the ends and sides of each slab.

Street Work in Port Arthur

Paving costing $162,000 done by city forces at a considerable saving over contract work. Loading chute a great money and time saver.

The city of Port Arthur, Texas, has sold bonds to the amount of $270,000 for improving the streets of the city, and by the end of the fiscal year 1919-20 had spent $162,221 of this amount. Full preparation had been made for the work as soon as the issue was voted, but before the bonds had been actually sold, including equipment and tools costing approximately $10,000, and within 24 hours after receipt of the money from the bonding company the equipment was in operation, and material for which contracts had previously been made was on the way to the city. The estimates of the work were made in the spring of 1919, but up to the time of this report the work (which was done by the city by day labor) had been done at a considerable reduction below the estimated cost, in spite of increased prices, the difference being $25,602 on an expenditure of $162,221.

A considerable part of this saving was made possible by the construction and use of a loading chute at the city dock where the shell used for road surfacing was received by barge and unloaded. In previous years the shell had been unloaded on the bank and reloaded into wagons. By the present method the shell is unloaded from the barge directly into a chute, from which it is loaded by gravity into the wagons. The total cost of the chute was under $300. By its use a 2-cubic-yard wagon can be loaded in two minutes and the price of delivery from the chute is now $.45 a cubic yard as against $.85 when it was loaded from the ground. This saving of $.40 a yard gives a saving of $24,000 on the 60,000 yards that will be used on the work.

It was realized that a shell road was not a permanent improvement nor even a very durable one, but it seemed desirable to secure some kind of improvement in front of all the built-up property and the bonding capacity of the city did not permit any larger expenditure; also, a considerable amount of storm sewer construction was anticipated and it was undesirable to construct a

more expensive pavement until this had been completed. This point is referred to by the city engineer, Clarence E. Ridley, in the concluding paragraphs of his report in which he states that a well-defined plan of permanent street paving should be perfected which would cover a period of ten years, realizing that a shell road has only temporarily lifted the city out of the mud, where it will be again in a few years unless other improvements are made.

Of the cost of the road construction 13½ per cent was drainage, 3½ per cent was grader work, 1½ per cent rolling, 37½ per cent shell, 10 per cent gravel, 25 per cent bridges and culverts, 4½ per cent engineering and 4½ per cent miscellaneous.

With shell roads, maintenance is an important item, since these deteriorate very rapidly when once they are allowed to get into a condition to hold puddles of water after a rain. The city has purchased a combined grader and scarifier and a tractor to draw it and expects to secure more efficient and lasting work at less expense with this equipment.

For cleaning the streets, the city in September, 1919, purchased a street flusher to replace a street broom and a 2½-ton truck and a labor force of 7 men. One man operates the flusher 3 hours each afternoon and 8 hours each night in the business district. Pavements in the residence district are flushed once every 3 days and the business district once every 24 hours. The appearance of the street and the health of the citizens are said to be improved by this system of cleaning, in addition to which the total saving the first 7 months the flusher was in operation was $2,778 over the old method. As the cost of the flusher was $2,152, City Engineer Ridley states that the flusher has already more than saved its cost; $4,000 has been appropriated for street cleaning for the present year as against $9,000 appropriated for this purpose two years ago.

Labor for Public Works

Reports from nearly six hundred city engineers in all parts of the United States show that there is plenty of unskilled labor for carrying out all the public work contemplated by cities for 1921, and that the wages will be very much lower than last year. The reports from all cities are tabulated on the following pages.

During the past month we have secured data and opinions from about six hundred city engineers located in all sections of the country relative to the amount and wages of unskilled labor available for public work. This information was obtained in response to the three questions: "Will there be enough unskilled labor available for public works contemplated for 1921 in your city and vicinity?" "What is the present prevailing price of unskilled labor?" "What do you think it will be next spring?"

There were, of course, a few who hesitated to reply to one or more of these questions and others who expressed some uncertainty, but in the great majority of cases direct and definite replies were received. As the informants were city engineers who are in touch with the public works done in their city and vicinity, it would seem probable that the opinions are at least as valuable and reliable as those which could be obtained from any other class of men. The dependence which can be placed upon these replies is increased by the remarkable unanimity of opinion found in the answers submitted.

ABUNDANCE OF LABOR

Of the replies received and tabulated up to January 20th, 361 expressed an opinion as to whether there would be enough unskilled labor for the public work contemplated for 1921. Of these, 335 stated that there would be, 14 that there probably would be, 3 that there probably would not be, 7 were certain that there would not be, and 2 were doubtful. It certainly had not been anticipated by us that such a very large percentage of our informants would find labor conditions in their vicinities so favorable for public work this year. With such a large proportion of the country provided with abundant labor, it would seem probable that the 7 to 12 places where labor was expected to be scarce could draw upon the rest of the country for any deficiency.

This consensus of opinion of so many men competent to judge would appear to guarantee that public work will not be delayed this year because of scarcity of labor.

WAGES

In the matter of wages there was, as might be expected, great variation in the amounts paid. But here also the unanimity of opinion as to probable reduction of wages for next spring's work is remarkable. The cities replying were grouped according to geographical districts as indicated on the accompanying map, and the average wages now paid was obtained for each group and also the average wages which will probably obtain next spring. Comparing the two averages in each geographical division, the percentage of reduction in wages was calculated and

UNSKILLED LABOR IN UNITED STATES CITIES

Cities and States	Enough unskilled labor for 1921 public works?	Present prevailing wages	Hours per day	Probable wages next spring
Alabama:				
Andalusia	....	$2.00	8	$1.25
Bessemer	Yes	3.00	8	Somewhat less
Montgomery	Yes	2.00-3.00	9	2.50
Arizona:				
Bisbee	Yes	4.50	8	4.50
Tucson	....	3.00-5.00	8	Lower
Arkansas:				
Fort Smith	....	0.40-0.50	..	0.30-0.35
Hot Springs	Yes	2.70	9	Same
Little Rock	Yes	2.50-3.00	9	1.50-2.00
Parasheat	No	3.00	10	2.00-2.25
Texarkana	Yes	2.50	9	2.00
California:				
Anaheim	Yes	4.50	8	4.50
Bakersfield	Yes	5.00-6.00	8	5.00-6.00
Calexico	Yes	4.00	8	3.00-3.50
Chico	Yes	3.50	8	4.00
Napa	Yes	5.00	8	4.00
Oroville	Yes	4.00	8	....
Palo Alto	Yes	4.00-6.00	8	4.00-6.00
Porterville	Yes	4.50	9	3.50
San Francisco	....	6.00	8	6.00
Santa Monica	....	5.00	8	....
Vallejo	Yes	6.00	8	6.00
Venice	Yes	4.50	8	3.00
Ventura	Yes	4.00	8	4.00
Colorado:				
Denver	Yes	4.00-5.00	8	4.00-5.00
Greeley	Yes	4.00-5.00	8	Lower
La Junta	Probably	4.00	8	Lower
Leadville	....	4.50	8	4.00
Longmont	Probably	3.60-4.50	9	3.00-4.00
Monte Vista	....	4.00	8	0.35-0.40
Pueblo	....	4.00	8	3.50-4.00
Connecticut:				
Bristol	Yes	5.40	9	0.50
Hartford	Yes	4.25	8	4.00
Manchester	Yes	4.50	9	3.75-4.00
Meriden	Yes	3.50-4.00	8	3.00-3.50
New Britain	....	4.86-5.83	9	4.86
New Canaan	....	5.00	8	4.00
New Haven	Yes	3.60-4.00	9	0.40-0.50
Orange	Yes	6.00	9	5.00
Putnam	Yes	3.50	9	4.00
Southington	Yes	4.50	9	3.00-3.50
Torrington	Yes	5.00	8	4.25
Wallingford	Yes	4.50-5.50	9	4.00-4.50
Delaware:				
Lewes	Yes	4.00	9	3.75
District of Columbia				
Washington	Yes	3.88	8	3.88
Florida				
Fort Myers	Yes	3.00	9	3.00
Orlando	Yes	3.00	10	2.50
Sanford	Yes	3.00	9	2.50
Georgia:				
Albany	Yes	2.00	10	1.50
East Point	Yes	2.50	10	2.00
Idaho:				
Boise	Yes	4.00	8	Lower
Idaho Falls	Yes	5.00	8	4.00-4.50
Malad	....	4.00	8	3.00
Nampa	Yes	5.00	8	4.00
Illinois:				
Benton	....	6.00	8	6.00
Canton	Yes	4.00	8	Same
Carlyle	....	4.00	8	2.50-3.00
Centralia	Yes	0.65	8	0.50-0.60
Champaign	Yes	4.50	9	4.00 10 hours
Chicago	Yes	8.10	9	8.10
Collinsville	Yes	0.75	8	0.75 an hour
Danville	Yes	4.00	8	0.45-0.50
Galena	Yes	4.00	8	....
Galesburg	Yes	0.50	8	0.50
Geneva	....	0.65-0.75	..	0.60-0.65
Joliet	....	6.30	9	7.00 10 hours
Kankakee	Yes	4.50	8	....
Kewanee	Yes	4.80	8	4.00
La Grange	Yes	1.00 per hour	8	0.87½
Marion	....	6.00	8	Same
Morrison	Yes	5.00	9	3.50-4.00
Mt. Carroll	Yes	4.00	8	5.00 10 hours
Murphysboro	Yes	5.20	8	5.20
Ottawa	Yes	0.60	8	0.50
Pana	Yes	4.00	8	4.00
Pekin	Yes	4.80	8	3.60
Streator	....	7.20	8	....
Taylorville	Yes	4.50	8	2.40-2.60
Waukegan	Yes	6.00	8	0.65
Winnetka	Yes (?)	$.75-1.00	8	Same
Indiana:				
Bedford	Yes	4.50	10	4.50
Bicknell	Yes	5.00	10	4.00
Covington	No (?)	3.00-3.50	10	Lower
Crown Point	Yes	4.00	8	3.20
Elkhart	Yes	5.00	9	0.40-0.50
Elwood	Yes	5.00	10	4.50
Fort Wayne	Yes	4.50	10	4.00
Franklin	Yes	5.00	10	3.50-4.00
Gary	Yes	5.00	10	4.00
Greenfield	Yes	4.00	10	0.35
Hartford City	Yes	5.50	10	4.00-4.40

UNSKILLED LABOR IN UNITED STATES CITIES (Continued)

Cities and States	Enough unskilled labor for 1921 public works?	Present prevailing wages	Hours per day	Probable wages next spring
Indiana (Continued)				
Huntington	No	5.00-7.00	10	Not much better
Jennings	Yes	3.50	9	3.50-4.00
Lafayette	Yes	0.45	9	0.35
Linton	Yes	5.00	8	Lower
Noblesville	....	3.50	10	3.00
La Porte	Yes	5.00	9	5.00
Peru	Yes	4.50	10	4.00
Shelbyville	Yes	5.40	9	4.00-4.50
South Bend	Yes	6.00	10	5.00
Terre Haute	Yes	3.20	8	2.50
Iowa:				
Adair	Yes	4.00	10	3.50-4.00
Albia	Yes	4.05	9	0.30
Boone	Yes	4.00	8	4.00
Cedar Falls	Yes	5.00	10	4.00
Cedar Rapids	....	4.80	8	....
Charles City	Yes	5.00	10	4.50
Cherokee	Yes	0.40-0.50	....	No higher
Correctionville	Yes	0.60	....	Same or less
Davenport	Yes	4.05	9	4.05
Denison	....	6.00	10	....
Emmetsburg	Probably	5.00	10	4.00-5.00
Fort Dodge	Yes	0.50-0.60	....	0.40-0.48
Kingsley	Yes	0.60	....	Same or less
Mason City	Yes	5.00	9	4.00
Muscatine	Yes	0.35-0.45	....	0.35-0.40
New Hampton	Yes	4.50	10	3.50
Storm Lake	Yes	5.00	10	5.00
Tabor	Yes	4.00	10	3.50-4.00
Villisca	Yes	4.00	10	3.50-4.00
Waverly	Yes	4.50	10	4.00
Kansas:				
Council Grove	Yes	4.00	8	Lower
Dodge City	Yes	4.00	8	3.20
Fort Scott	Yes	4.00	8	3.20
Hiawatha	....	0.50	8	0.50
Hutchinson	....	0.40-0.50	8	Lower
Independence	Yes	4.00	8	3.50
Manhattan	Yes	4.00	8	2.80-4.00
McPherson	Yes	4.00	8	3.00
Ottawa	Yes	3.50-4.00	8	3.50-4.00
Salina	Yes	4.00	8	3.00-4.00
Winfield	Yes	4.00	8	3.00
Kentucky:				
Ashland	Yes	4.00	9	4.00
Maysville	Yes	0.45-0.50	8-10	Lower
Newport	Yes	3.60	9	3.00
Owensboro	Yes	3.00	10	Same or less
Richmond	Yes	3.50	10	2.50
Louisiana:				
Crowley	Yes	0.25	10	0.20
Kentwood	Yes	2.50	10	....
Minden	....	3.00	8	3.00
South Highlands	Yes	0.30-0.40	9-10	0.20-0.30
Maine:				
Bangor	Yes	4.50	9	3.50-4.00
Gardiner	Probably not	4.00-5.00	8-9	Same
Paris	Yes	3.50	9	3.50
Portland	Yes	5.20	8	5.00
Rockland	Yes	4.00	9	3.00-3.50
Westbrook	Yes	0.50	9	0.40
Maryland:				
Hagerstown	....	3.00	10	3.00
Massachusetts:				
Athol	Yes	4.50	9	4.00
Arlington	Yes	4.50	8	....
Andover	Yes	5.00	8	4.00-4.50
Attleboro	Yes	4.80	8	4.00
Boston	Yes	4.80	8	0.40-0.50
Braintree	Yes	5.00	9	4.00
Brookline	Yes	4.50	8	4.50
Chicopee	Probably	5.00	8	....
Easthampton	Yes	4.00	8	3.20
Haverhill	....	4.75	8	4.75
Lexington	Yes	4.75-5.00	8	Lower
Lee	Yes	4.00	8	4.00
Lynn	Yes	....	8	Same
North Adams	Yes	4.50	8	3.50
Orange	....	4.00	8	Lower
Pittsfield	Yes	5.00	8	4.00
Somerville	....	4.00	8	Lower
Spencer	Yes	4.00	8	....
Wakefield	Yes	4.50	8	....
Waltham	Yes	4.66	8	4.66
Watertown	Yes	5.00	8	5.00
Michigan:				
Alma	Yes	4.00-5.00	10	3.50
Ann Arbor	Yes	5.40	9	4.50
Crystal Falls	Yes	4.23	9	3.50
Detroit	....	4.50	8	3.60
Dowagiac	Yes	4.50	9	4.00
Escanaba	Yes	5.00	8	4.00
Flint	Probably	5.00	10	5.00
Grand Haven	....	0.50	....	....
Howell	Yes	5.40	9	4.00
Hastings	Yes	4.50	10	4.00
Hudson	....	5.50	9	3.50-4.50
Ironwood	Yes	4.85	8	3.50
Jackson	Yes	3.60	8	Not over 4.00
Lansing	....	3.60-5.40	9	....
Muskegon	Yes	4.00	10	4.00
Port Huron	Yes	4.50	9	4.00

UNSKILLED LABOR IN UNITED STATES CITIES (Continued)

Cities and States	Enough unskilled labor for 1921 public works?	Present prevailing wages	Hours per day	Probable wages next spring
Michigan (Continued)				
Sturgis	Yes	4.50	9	3.50-4.00
Three Rivers	Yes	0.60	10	0.55
Wyandotte	....	5.00-6.50	10	6.00
Ypsilanti	Yes	4.50	9	0.50
Minnesota:				
Albert Lea	Yes	5.00	10	5.00
Cloquet	....	0.45	10	0.45
Fairmont	Think so	6.00	10	5.00
Faribault	Doubtful	5.00-5.50	10	3.50-4.00
Farmington	....	0.35	9	0.40-0.45
Hibbing	Yes	5.00	8	5.00
Little Falls	....	4.00	10	3.50
Luverne	Yes	0.60	....	Same or less
Minneapolis	Yes	5.00	8	5.00
Montevideo	Yes	5.00	10	5.00
St. Paul	Yes	5.00	8	3.50
St. Peter	Yes	4.00	10	3.00-4.00
Two Harbors	Yes	0.65	8	0.50
Virginia	Yes	5.00	8	5.00
Winona	Yes	4.00	8	4.00
Mississippi:				
Canton	Yes	2.50	10	1.75
Clarksdale	Yes	2.50	10	Same or less
Laurel	Yes	3.50	10	2.50
Missouri:				
Bethany	Yes	5.00-6.00	10	....
Carthage	..	4.00	9	3.00
Fredericktown	Yes	3.00	10	3.00
Fulton	..	3.20-4.00	8	3.20
St. Louis	Yes	4.50	9	0.35-0.40
Sedalia	Yes	4.00	10	3.50
St. Charles	Yes	4.05	9	3.60
Montana:				
Billings	Yes	5.50	8	4.50
Bozeman	Yes	5.00	8	4.00-4.50
Great Falls	Yes	5.50	....	4.50
Lewiston	Yes	5.00	8	5.00-4.00
Nebraska:				
Columbus	No	6.00	10	Probably higher
Fremont	Yes	5.00	10	4.00
Hastings	Yes	5.00	10	Not over 4.00
Homer	Yes	0.60	..	Same or less
Lincoln	Probably	4.50	10	4.00
Norfolk	Yes	4.00	10	4.00
Omaha	Yes	0.65	..	0.45
Red Cloud	Yes	5.00	10	4.00
Scotts Bluff	Yes	4.50	9	4.00
Nevada:				
Reno	Yes	4.50	8	4.00
New Hampshire:				
Laconia	Probably	4.25	9	4.25
Portsmouth	Yes	4.50	8	4.00
New Jersey:				
Bloomfield	Yes	6.50	9	4.50
Bordentown	Yes	4.50	9	3.60
Clifton	....	4.80	8	3.50-4.00
Garfield	Yes	5.40	9	Lower
Highland Park	Yes	5.40	9	4.50
Madison	Yes	3.00-6.00	9	..
Montclair	Yes	4.50	8	Lower
Newark	Probably	6.00	9	5.00
New Brunswick	Yes	0.55	..	0.50
Passaic	Probably	0.65	..	..
Plainfield	Yes	4.80	8	4.00
Red Bank	....	4.50	9	..
Ridgefield Park	Probably	5.00	8	5.00
Roselle	....	5.00-6.00	9	4.00-5.00
Rutherford	Yes	5.20	8	..
Somerville	Yes	3.20	8	3.20
South Orange	Yes	4.50	8	4.50
Westfield	Yes	6.00	9	4.50
West Hoboken	....	5.50	10	4.00-4.50
West Orange	Yes	5.00	8	4.00
New York:				
Binghamton	Yes	4.00-4.80	8	3.50-4.00
New York—				
Brooklyn Borough	Yes	5.00	8	5.00
Manhattan Borough	Yes	3.00-3.50	8	Same or lower
Buffalo	....	4.40-4.80	8	....
Corning	Yes	0.50	8	0.40
Endicott	Yes	0.45-0.55	8½	0.45-0.50
Geneva	....	5.00	8	4.00
Gloversville	....	4.00	8	3.50-4.00
Haverstraw	....	3.50	8	3.50
Herkimer	Yes	0.50	9	0.50
Hudson Falls	Yes	4.00	8	Less
Lackawanna	Yes	4.00	8	3.50
Little Falls	Yes	5.20	8	4.40
Mamaroneck	....	5.00-7.00	8	....
Niagara Falls	Yes	0.65-0.70	....	0.55-0.60
North Tonawanda	Yes	4.00	8	4.00
Ogdensburg	Yes	3.00	8	No less
Olean	Yes	4.00	8	Lower
Oneida	Yes	5.20	8	4.00
Oneonta	Yes	0.55	....	0.40-0.45
Salamanca	Yes	4.00	8	3.60
Schenectady	Yes	0.70	8	0.50-0.60
Tarrytown	Yes	4.50	8	4.00
Troy	....	4.00	8	....
Watertown	Yes	4.00	8	0.40
Watkins	....	4.25	8	3.25

UNSKILLED LABOR IN UNITED STATES CITIES (Continued)

Cities and States	Enough unskilled labor for 1921 public works?	Present prevailing wages	Hours per day	Probable wages next spring
North Carolina:				
Durham	Yes	3.00	9	Same
Fayetteville	Yes	3.50	10	Not less than 3.00
Greensboro	....	3.50	10	3.00
Monroe	Yes	2.50	10	1.50-2.00
Statesville	Yes	4.00	10	3.00
Washington	Yes	0.30	10	0.25
North Dakota:				
Bismarck	Yes	4.50	9	3.50-4.00
Fargo	Yes	5.00	10	4.00
Valley City	....	0.45	9	0.35-0.40
Ohio:				
Akron	Yes	3.60	9	3.00-3.60
Alliance	Yes	4.00-4.50	8	3.50-4.00
Bellaire	....	4.00	8	4.00
Bucyrus	Yes	4.00	10	0.30-0.35
Chillicothe	Yes	0.40	9-10	0.40
Circleville	No	0.40-0.50	8	0.40
Columbus	Yes	5.00	8	4.00-4.50
Cuyahoga Falls	....	0.50	10	0.50
Delaware	Yes	4.50	10	0.30
East Liverpool	Doubtful	5.00	9	Same
East Youngstown	Yes	3.60	8	3.60
Findlay	Yes	5.00	9	Less
Fremont	Yes	4.50	9	4.50 10 hours
Lakewood	....	5.20	8	4.00
Lancaster	Yes	4.00	8	3.50-4.00
London	Yes	4.00	8	Same
Lorain	Yes	0.55	8	0.50
Marietta	Yes	3.50	8	2.50
Marion	Yes	5.00-6.00	10	5.00-6.00
Norwalk	Yes	4.50	8	....
Oak Hill	....	3.75	8	3.00
Troy	....	5.50	10	0.50
Urbana	....	4.50	10	3.00
Wooster	Yes	4.00	8	3.60
Xenia	Yes	4.00	8	3.00
Zanesville	Yes	4.80	8	4.00 or less
Oklahoma:				
Alta	Yes	4.00	8	3.00 or less
Bartlesville	Yes	4.00	8	....
Durant	....	3.20	8	Less
Enid	Yes	5.00	8	5.00
McAllister	Yes	3.25	8	....
Oklahoma City	....	4.00	8	3.20
Shawnee	Yes	4.00	8	....
Wagoner	Yes	3.20-4.00	8	Less
Oregon:				
Astoria	Yes	5.50	8	5.50
Corvallis	Yes	5.00	8	4.00
Eugene	Yes	4.00-5.00	8	3.50-4.00
Salem	Yes	4.50	8	3.50-3.75
Pennsylvania:				
Allentown	Yes	5.00	10	Lower
Altoona	Yes	4.00-6.00	10	3.00-4.00
Beaver Falls	Yes	6.00	10	4.00
Berwick	Yes	4.05	9	3.00-3.60
Bethlehem	Yes	0.40	....	0.32
Bloomsburg	....	3.50	8	....
Bowmanstown	Yes	3.50	10	3.00
Chester	Yes	5.00	10	4.00
Connellsville	Yes	4.50-5.00	9	Lower
Dorranceton	....	3.20-4.00	8	Same
Dormont	Yes	6.00	10	....
Duquesne	Yes	6.00-6.50	10	....
East Bangor	Yes	4.00	10	3.00-3.50
Easton	....	....	....	0.30-0.35
Ellwood City	Yes	5.00	9	4.00-4.50
Franklin	Yes	4.00	8	....
Freeland	Yes	4.50	9	Lower
Gallitzen	Yes	5.00	9	4.50
Harrisburg	Yes	0.40	8	0.30
Huntington	Yes	4.00	10	3.00
Johnstown	Yes	5.00	10	....
Lebanon	Yes	4.50	10	3.50-4.00
Lehighton	Yes	3.50	10	3.00
Mechanicsburg	Yes	4.00	8	3.50
Monongahela	Yes	5.00	8	Lower
Norristown	Yes	4.50	9	0.35-0.40
North Braddock	....	4.20	10	4.20 or less
Oil City	Probably not	4.00	8	About same
Parkesburg	Yes	2.00	10	Same
Pottsville	....	4.50	9	....
Rankin	Yes	4.50	10	About same
Reading	Yes	5.00	10	3.50
Schuylkill Haven	....	5.00	10	About same
Scranton	Yes	4.50	9	4.50
Sharon	Yes	5.00	9	4.50
Slatington	Yes	3.50	10	3.00
Stroudsburg	Yes	4.00	9	Less
Sawyersville	Yes	0.40-0.50	9	Same
Titusville	Yes	0.50	..	0.40
Tyrone	Yes	3.50	10	....
Uniontown	Yes	4.50-5.50	9	Same or lower
West Homestead	....	4.50	10	3.50
Wilkinsburg	Yes	6.00	10	Lower
York	Yes	5.00	10	3.50-4.00
Rhode Island:				
Bristol	Yes	3.60	9	3.60
Woonsocket	Yes	0.50	..	Less
South Carolina:				
Charleston	Yes	2.00-2.50	9	2.00-2.25
Greenville	Yes	2.50	10	2.25

UNSKILLED LABOR IN UNITED STATES CITIES (Continued)

Cities and States	Enough unskilled labor for 1921 public works?	Present prevailing wages	Hours per day	Probable wages next spring
South Carolina (Continued)				
Greenwood	Yes	2.50	10	2.50
Orangeburg	Yes	0.20		0.15
Union	No	2.50	10	Perhaps less
South Dakota:				
Mitchell	Yes	5.50	10	5.00
Rapid City	Yes	0.60	..	Same or less
Tennessee:				
Cleveland	Yes	3.50	10	2.50
Dyersburg	Yes	3.00	10	2.00
Greenville	....	3.00	10	2.00
Texas:				
Amarillo	Yes	5.00	8	4.00
Beaumont	Yes	2.75-3.50	8	2.25-2.50
Belton	Yes	3.20	8	2.80
Brenham	....	2.50-3.50	8	2.00-3.00
Brownwood	Yes	3.50-4.00	8	2.00-2.50
Clarksville	Yes	2.00	8	1.50
Cleburne	Yes	3.50	8	2.50
Corpus Christi	Yes	2.50	8	2.50
Dallas	Yes	3.50	8	3.00
Ennis	Yes	3.00	8	3.00
Galveston	....	4.00	8	3.20
Greenville	Yes	3.00	8	2.50
Longview	Yes	2.50	8	Same or less
Mineral Wells	Yes	3.50	8	3.00
Port Arthur	Yes	3.75	8	Lower
San Angelo	Yes	3.50	8	2.50-3.00
Temple	Yes	3.50	8	3.00
Waco	Yes	3.50	8	About same
Waxahachie	Yes	3.00	8	2.50
Weatherford	....	3.50	8	3.00
Utah:				
Ogden	Yes	3.50-4.00	8	3.50
Provo City	Yes	4.50	8	4.00
Vermont:				
Burlington	Yes	3.50	9	3.00 or less
Middlebury	Yes	0.35	9	0.30
Montpelier	Yes	4.00	48 hrs. a week	Same
St. Albans	Yes	3.25	9	About same
Springfield	....	4.00-4.50	9	3.50-4.00
Virginia:				
Charlottesville	Yes	3.00	10	2.50
Clifton Forge	Yes	3.60	9	3.00
Danville	Yes	3.50-4.00	10	3.00-3.25
Hampton	Yes	0.35	9	Less
Newport News	Yes	0.40-0.44	8	0.35-0.40
Norfolk	Probably	3.60	8	3.00
Pulaski	....	3.00	8	Lower
Washington:				
Charleston	Yes	5.00	8	4.00-4.50
Chehalis	Yes	5.00	8	4.50-5.00
Okanogan	Yes	4.00	8	4.00
Olympia	Yes	6.00	8	4.50
Port Townsend	Yes	4.00-4.50	8	Not much lower
Raymond	Yes	5.50	8	5.50
Spokane	Yes	4.50	8	4.00
Walla Walla	Yes	5.00-6.00	8	4.00-4.50
West Virginia:				
Fairmont	....	0.50	....	0.40
Parkersburg	Yes	4.50	9	4.00
Wisconsin:				
Appleton	Yes	5.00	9	Less
Augusta		3.00	10	3.00
Baraboo	Yes	0.35	....	Same
Beaver Dam	Shop work, yes; other no.	4.50-6.00	10	4.00
Beloit	Yes	5.00	10	3.00-4.00
Delavan	Probably	5.00	10	4.50-5.00
Eau Claire	Yes	0.45	8	0.35-0.40
Kaukauna	Yes	4.00	10	3.00
Madison	Yes	5.00	9	4.50
Manitowoc	Yes	0.50	8-10	0.50
Marinette	Probably	4.00	10	....
Oshkosh	Probably	5.40	9	5.00
Racine	Yes	4.00-5.00	10	Same or lower
Rhinelander	Yes	4.25	8	4.00
Sheboygan	Yes	4.50	10	3.15-4.05
Superior	Yes	5.00	10	Less
Waukesha	Yes	0.35-0.40	9	0.30-0.35
Wisconsin Rapids	Probably not	4.00	8	4.00

The above data were received prior to January 20th, and tabulation begun on that date. The tabulation below includes those received after that date and up to February 1st.

Alabama:				
Gadsden	Yes	$3.00	10	$3.00
Arizona:				
Douglas	Yes	3.00	8	2.75
Prescott	Yes	5.00	8	4.00
Winslow	Yes	4.50	8	Less
Arkansas:				
Pine Bluff	Yes	2.50	10	2.00
California:				
El Centro	....	4.00	8	3.50
Pasadena	Yes	4.50	8	Same
San Luis Obispo	Yes	4.50	8	4.00
Canada:				
Toronto, Ont.	....	.60	....	....

UNSKILLED LABOR IN UNITED STATES CITIES (Continued)

Cities and States	Enough unskilled labor for 1921 public works?	Present prevailing wages	Hours per day	Probable wages next Spring
Colorado:				
Boulder	Yes	3.25	8	[illegible]
Salida	Yes	4.50	8	3.50-4.00
Connecticut:				
Ansonia	Yes	4.00	8	
Derby	Yes	4.00	8	
Milford	Yes	.50	9	.40
Norwich	Yes	4.00	8	Same
Shelton	....	.65	....	....
Stamford	Yes	4.00	8	3.50
Waterbury	Yes	.30-.35	9	.25-.30
Georgia:				
Augusta	Yes	.25	9	.25
Idaho:				
Couer d'Alene		4.00	8	4.00
Illinois:				
Cairo	Yes	.35		.20
Chicago Heights	Yes	.70	9	
Cicero	Yes	7.00	8	7.00
Decatur	Yes	4.50	9	4.50
Evanston	Yes	5.00	8	
Moline	Yes			.40-.45
Oak Park	Yes	.60	8	.60
Olney		3.00	9	
Quincy		.45		.40
Savanna	Yes	.50		
Wheaton	Yes	7.00	10	7.00
Wilmette				.50
Zion	Yes	5.40	9	4.50
Indiana:				
Crawfordsville	Yes	4.00	8	4.00
Evansville	Yes	4.50	10	3.50-4.00
Kokomo	Yes	4.00-5.00	10	3.00-3.50
New Albany	Yes	4.00	10	3.50
Wabash	Yes	4.00-4.50	10	.30-.40
Iowa:				
Knoxville		3.20-4.00	8	Same
Kansas:				
Arkansas City	Yes	5.00	8	4.00-5.00
Columbus	Yes	3.20	8	3.20
Kansas City	Yes	3.20	8	Same or less
Wellington	Yes	4.00	8	3.60
Louisiana:				
La Fayette	Yes	2.00	10	1.50-1.75
Monroe	Yes	2.50-3.00	10	2.50
Maine:				
Lewiston	Probably	4.50	9	....
Waterville	Yes	4.00	9	Less
Maryland:				
Frederick	Yes	3.50	9	3.00
Massachusetts:				
Brockton	Yes	.68	8	....
Danvers	Yes	4.25	8	4.25
Holyoke	Yes	4.75	8	
Lawrence	Yes	5.00	8	5.00
Lowell	Yes	4.50	8	4.50
Malden	Yes	4.00-4.50	8	4.00-4.50
Medford	Yes	4.75	8	
Needham	Yes	4.50	8	4.50
Newton	Yes	4.25-4.40	8	4.25-4.40
Provincetown		3.00	8	3.00
Webster	Yes	3.50	8	3.00
Michigan:				
Albion	Yes	4.50	9	3.60
Battle Creek	Probably	5.40	9	About same
Bay City	Yes	5.00	8	5.00
Holland	Yes	4.50	9	4.00
Haughton		3.00-3.50	9	About same
Ishpeming	Yes	4.75	8	4.35
Munising	Yes	4.00	10	Lower
Saginaw		.45	8	.50-.55
Minnesota:				
Chisholm	Yes	5.00	8	About same
Eveleth		5.00		
Northfield	Yes	5.00	10	3.00-4.00
St. Cloud	Yes	3.50	10	4.50-5.00
Mississippi:				
Tupelo	Yes	2.50	10	2.00
Missouri:				
Brookfield	Yes	.50	9	.40-.50
Jefferson City	Yes	3.60	9	3.60
Maplewood	Yes	.55		.45-.50
Poplar Bluff	Yes	2.00	10	1.75
University City	Yes	2.80	8	.30
Montana:				
Havre	Yes	4.80	8	4.80
Missoula	Probably	5.00	8	
Nebraska:				
Nebraska City	Yes	.50	10	.35-.40
North Platte	Yes	7.00	10	6.00
New Jersey:				
Bridgeton		3.60	9	3.00
Long Branch	Yes	4.00	8	Lower
Millville	Yes	3.50	9	3.00
Orange	Yes	5.00	8	4.00
Roosevelt	Yes	4.50	8	3.60
Roselle Park	Probably	6.00	9	5.50
West New York	Yes	5.00	8	5.00
New York:				
Albany	Doubtful	4.40-5.20	8	3.50-4.50
New York, Bronx Borough		5.00-6.00	8	Lower
Ellenville	Yes	3.00	9	2.50
Elmira	Yes	4.00	8	4.00

UNSKILLED LABOR IN UNITED STATES CITIES (Continued)

Cities and States	Enough unskilled labor for 1921 public works?	Present prevailing wages	Hours per day	Probable wages next spring
Glens Falls	Probably	4.00	8	About same
Hastings-on-Hudson	Yes	3.25	8	3.25
Hornell	Yes	4.80	8	4.00
Ithaca		4.00	8	About same
Jamestown	Yes	4.00	8	
Lockport		5.00	8	5.00
Port Chester	Probably	5.00	8	4.00
Syracuse	Probably	3.20	8	Same or lower
North Carolina:				
Asheville		3.00	8	2.00
North Dakota:				
Grand Forks	Yes until fall	4.00-5.00	9	5.00-6.00
Ohio:				
Marysville	No	4.00	10	4.00
Niles	Yes	5.00	10	5.00
Sidney	Yes	3.00-3.50	10	2.75-3.00
Washington, C. H.	Yes	3.25	8	
Oklahoma:				
Hobart	Yes	4.00	8	4.00
Lancaster	Yes	4.00	8	No more
Pennsylvania:				
Bradford		5.00-6.00	8	Not less than 4.00
Clearfield	Yes	4.00	8	3.50
Corry	Yes	4.50	9	No change
Dickson City	Yes	4.00	8	4.00
Erie	Yes	4.50-6.00	10	
Greenville	Doubtful	.50		.50
Hanover	Yes	3.50	10	3.50
Hazelton	Yes	4.50	10	
Hollidaysburg		4.50	10	
Jersey Shore		4.50	9	3.00-3.50
Media		4.50	8	Lower
Philadelphia	Yes	.45-.50		.45-.55
Pittsburgh	Yes	4.00	10	3.50
Punxsutawney		3.50	10	About same
Sayre	Yes	3.50	9	3.00
Summit Hill		5.00	10	.50
Wilkes-Barre	Yes	.40	9	.40
Woodlawn		5.00	10	
Rhode Island:				
Newport	Yes	4.00	8	4.00
Pawtucket	Probably			
South Carolina:				
Manning	Yes	1.50	10	
Spartanburg	Yes	.20	10	.15
South Dakota:				
Aberdeen	Yes	.40-.50		.35-.45
Sioux Falls	Probably	4.80	8	4.00
Watertown	Yes	4.00-5.00	10	4.00
Tennessee:				
Clarksville		2.50	10	2.00
Texas:				
Denham	Yes	2.50-3.50	8	2.50
Childress	Yes	4.00	8	3.00-3.50
Cisco	Yes	4.00	8	3.00
Eastland	Yes	4.00	8	3.50
Utah:				
Brigham City	Yes	5.00	8	5.00
Vermont:				
Barre	Probably	4.00	8	4.00
Bennington		4.80	8	
Virginia:				
Roanoke	Yes	3.60	9	3.60
Washington:				
Auburn	Probably	5.20	8	4.00
Port Angeles	Yes	5.00	8	4.50
West Virginia				
Grafton	Yes	3.50	10	3.00
Moundsville	Probably	3.60	9	Lower
Princeton	Yes	.45	9	.40
Wisconsin:				
Ashland	Yes	3.50	8	3.00
Edgerton	Yes	5.00	10	Same or less
Janesville	Probably not	4.50	9	5.00
Jefferson	Yes	4.00	8	
Lake Geneva	Yes	4.50	9	4.00
Menasha	Yes	.50	9	.50
Neenah	Yes	.50	9	.50

(*Continued from page* 121)

these percentages were as follows: New England, 8; Middle Atlantic, 11⅓; South Atlantic, 11½; East North Central, 11½; East South Central, 24¼; West North Central, 12¼; West South Central, 14⅔; Mountain, 12¼; Pacific, 11⅓.

It will be noted that of the nine groups, 6 anticipate a reduction of 11 and a fraction or 12 and a fraction percent; a seventh, 14 and a fraction percent; while the other two give 8 and 24, respectively. The 24 per cent of the East South Central is caused by the anticipated drop to an average wage of 25 cents per hour, which is by far the lowest average reported from any section. The relatively small anticipated drop in New England is caused by the comparatively low average of existing wages.

Another feature of the uniformity lies in the geographical distribution of the wage averages. Taking the anticipated 1921 wages, we find the northern tier of states, that is, New England, Middle Atlantic, East North Central and West North Central to report the wages as 46, 45, 46 and 43 cents, respectively; while the South Atlantic, East South Central and West South Central report 30, 25 and 35 cents, respectively.

A summary by geographical divisions has been made of the data contained in the complete table,

GEOGRAPHICAL DIVISIONS AS DEFINED BY THE BUREAU OF THE CENSUS.

giving not only the average, but also the maximum and minimum reported for each division. These show that, although the averages seem to follow a definite law, there are considerable variations within each division. For instance, in the Middle Atlantic division we find wages varying from 20 cents to 75 cents per hour, in the East North Central from 30 cents to 87 cents, etc.

Taking the entire country, we find the average wage at the present time is 48 cents an hour and that the average of the wages anticipated for next spring is 42 cents an hour, a reduction of 13 per cent.

It is to be noted that the drop in wages is not so great as it would have been had the question been asked a few weeks ago, the "present wages" being those of January, 1921, and not those of last summer and fall. For instance, one town in New Jersey reports the present prevailing price of labor as $4.50 per day, but that it has just been reduced from $5.50; while a North Carolina city reports that the wages there have just been cut from $4 to $3; these two showing a recent fall of 25 per cent in addition to the further fall anticipated. We had expected to learn of a greater anticipated reduction than that shown by the table, approximating more nearly to pre-war prices, especially in view of the apparent abundance of labor everywhere. It would seem, however, that reliance should be placed upon the opinions of these hundreds of observers, especially in view of the great uniformity of their ideas on this point.

Fortunately, reports from contractors (although by no means so many of these have reached us as the replies to the above questions) indicate that the efficiency of labor of all kinds has increased greatly and has recovered from 50 per cent to 100 per cent of its former departure from pre-war effectiveness.

SUMMARY OF GEOGRAPHICAL DIVISIONS

State Group	No. of cities reporting	Present Wage Per Hour Av.	Max.	Min	Probable Wage in Spring Av.	Max.	Min	Average percentage reduction
New England	39	50	65	35	46	62½	25	8
Middle Atlantic	61	53	75	20	45	62½	20	11 1-3
South Atlantic	24	34	69	20	30	53	15	11¾
East North Central	98	52	87½	30	46	87½	30	11½
East South Central	10	33	53	25	25	44	15½	24¼
West North Central	51	49	65	35	43	62½	30	12¼
West South Central	28	41	62½	25	35	62½	19	14 2-3
Mountain	16	57	69	40	50	56¼	33 1-3	12½
Pacific	20	62	75	50	55	75	37½	11 1-3
United States	347	48	87½	20	42	87½	15	13

BASE AND SUBGRADE FAILURES

City and State	What kind of pavement base has failed?	Thickness of base, inches	Wearing surface	Was failure due to traffic?	Description of traffic	Was failure due to yielding of subgrade?	* Cause of yielding
Arizona:							
Bisbee	Concrete	6	Brick	No		Yes	Pipe trenches and poor repair.
Arkansas:							
Little Rock	Concrete	5	Asphalt Concrete	No	Very light		Improper drainage and thin mix
California:							
Anaheim	Concrete	4½	Asphalt			Yes	Pipe trenches
Calexico	Concrete	5	Warrenite	Yes	750	Yes	Settlement of new embankment
Napa	Bituminous Concrete	3	Natural Bitumen	No		No	Not properly constructed and too high a crown
Palo Alto	Macadam & Concrete	4	2 in. Bit. Rock	Yes		No	
Porterville	Asphalt Concrete	4	None	No		Yes	Nature of soil
Ventura	Concrete	4	1 in. Warrenite	Yes	Heavy trucks		Adobe changes volume with wet and dry seasons
Colorado:							
Leadville	Macadam	4	2 in.	Yes	About 1,000 per day, light rigs to heavy auto trucks and ore wagons weighing up to 15,000 lbs.	Yes	Improper replacement of surface after excavation
Connecticut:							
Hartford	Cement Concrete	6	3 inch sheet asphalt			Yes	Pipe or conduit trench
Meriden	Concrete	6	Wood block	No		No	Probably due to poor construction
Florida:							
Sanford	Sand		Brick			Yes	Lack of drainage
Georgia:							
Albany	Concrete	6	Brick				Old ditch lines, cracks in sub-base
Illinois:							
Canton	No. 2 brick	2¼	Small pavers	Yes		Yes	Lack of drainage; trench openings made after pavement was laid
Carlyle	Macadam	6—8	Macadam	Yes	Fords to 7-ton trucks	No	No surface binder
Centralia	Natural Cement	6	Brick	No		Yes	Poor material
Danville	Concrete	5	Bitulithic	Yes	12-ton trucks	Yes	Lack of drainage of wet spots on slopes
Galena	Old Macadam	6—24	Vit. Block	No		Yes	Mostly pipe trenches
Joliet	Macadam	6	3½ in.	No		Yes	Poor drainage
La Grange	Concrete	6	Asphaltic Concrete	No		Yes	Where 36 in. fill was laid through old swamp; stood 4 years then settled slightly
Pana	Concrete	5	Brick 5 in. Sand Cushion	No	Light traffic	Yes	Black undrained soil, damp when pavement laid
Taylorville	Concrete	6	Brick & Vitrified Block	No	Fords to 10-ton trucks	Where service pipes were newly laid in advance of paving	Improper back-filling; also a street railroad was laid in cold weather and pavement not properly replaced
Waukegan	Macadam	6	Brick	No		Yes	Pipe trenches
Winnetka	Concrete	5	Brick, Tar Filler	Yes	Heavy motor truck traffic	Yes	Clay sub-soil; base too light; loads too heavy and fast
Indiana:							
Covington	Sand and Clay	4	Brick	No	All kinds of vehicles	Yes	Lack of drainage
Crown Point	Slag	6	Crushed Limestone	Yes	100 5-ton; 500 1 and 2-ton trucks; 1,000 autos	No	Neglected repairs to wearing surface
Elkhart	Concrete	6	2½ inch Asphalt	No	Ordinary traffic	Yes	Pipe trenches and mucky sub-soil
Elwood	Gravel & Sand	10	Brick	Rutting under truck traffic in early spring	Average 120 trucks 3-5-10-ton 400 autos daily	No	Partly fill; pushing of gravel and sand under weight
Franklin	Gravel	12	Brick	No			Poor drainage, causing surface to settle and blow up
Huntington	Stone	8	Brick	No		Yes	Trenches and drainage
South Bend	Concrete	5	Sheet Asphalt	Yes	Heavy truck traffic	No	Concrete in base not first class
Terre Haute	Stone & Gravel	12	Brick	No		Yes	Pipe and sewer trenches
Iowa:							
Boone	Natural cement Concrete	5	Brick	Yes	Heavy traffic of all kinds		
Centerville	Concrete	5—6	Brick	Yes	5 to 10-ton trucks	Yes	Also settlement of fill in a few cases
Fort Dodge	Concrete	5	Asphalt	Probably		Yes	
Muscatine	Macadam			Yes	10 to 20-ton trucks	Yes	Poor filling of gas and sewer trenches, especially when done in winter and soils not thawed out when refilled

BASE AND SUBGRADE FAILURES—(Continued)

City and State	What kind of pavement base has failed?	Thickness of base, inches	Wearing surface	Was failure due to traffic?	Description of traffic	Was failure due to yielding of sub-grade?	Cause of yielding
Kansas:							
Council Grove	Concrete	5	Brick	No		Yes	Base has cracked due to expansion and contraction of sub-base
Dodge City	Concrete	5	3 in. vertical fiber Brick block	No	300 autos; 100 horse-drawn vehicles	Yes	Contraction and expansion of base
Independence	Crushed Rock	6	Brick	Partially			Pipe trenches and bad drainage of sub-soil
Manhattan	Concrete	5	Asphaltic Concrete	No		Yes	Pipe trenches in some cases and lack of drainage in most cases
McPherson	Concrete	4	Asp. Concrete & Brick	No		Yes	Gumbo sub-soil
Salina	Macadam	6	2 in.	Yes	1 to 5-ton trucks; 3,000 a day	No	Bad mixture of asph. and aggregate
Ottawa	Concrete	5	Brick	Yes		Yes	Gumbo soil mostly
Winfield	Concrete	4	3 in. Brick	No	Autos and trucks	Yes	Shrinkage of gumbo sub-soil in drying
Maine:							
Bangor	Cement Conc. base	6	Wood block	No		Yes	Pipe trenches and lean concrete.
Massachusetts:							
Lee	Stone	6	Water-bound Macadam	Yes		Yes	Lack of drainage
Michigan:							
Detroit	Concrete	6	Asphaltic		Mostly 5-ton trucks	Yes	Pipe trenches mostly—poor filling material in
Muskegon	Concrete	3—7	Concrete	Yes			made ground
Port Huron	Concrete	6	Brick	Yes		Yes	Sawdust fills
Sturgis	Concrete	6	Brick	No		Yes	Lack of drainage—freezing
Ypsilante	Concrete	7	Concrete	No		Yes	Pipe trench
						Yes	Lack of drainage and hard compacted centers with uncompacted gutters
Minnesota:							
Albert Lea	Concrete	5	Wood-block	No		Yes	Across old slough bed peat soil.
St. Peter	Gravel	8—10	Gravel	Yes		Yes	Heaving caused by freezing of hard-pan under sub-grade.
Mississippi:							
Clarksdale	Concrete	5	1½ in. Asphaltic Concrete	No		Yes	Defects in Sewer lines
Missouri:							
Sedalia	Macadam	6	Vit. Brick	No		Yes	Pipe trench—lack of drainage
Montana:							
Billings	Concrete	4	1½ in. Bitulithic	Yes	600-800 some trucks weighing 12 to 15 tons	Yes	Lack of drainage; water table so near surface as to soften sub-grade
Great Falls	Concrete	4	2 in.			Yes	Heaving of ground
Lewiston	Concrete	6	Bitulithic	No		Yes	New embankment at bridge approaches
Nebraska:							
Lincoln	Concrete	5—8	Brick & Asphalt	No		Yes	Generally heaving due to frost at points of leaking water mains or services
Norfolk	Concrete	5	2 in. A. C.	No		Yes	Trenches and excessive frost upheaval
New Hampshire:							
Laconia	Cement Concrete	6	Tar Concrete	No		Yes	Lack of drainage
Portsmouth	Concrete & Gravel	6	Sheet Asphalt			Yes	Frost heaving small amt of new work where new trenches were, or, improper drainage
New Jersey:							
Montclair	Concrete	5	Asphalt Macadam	No		Yes	Street built over ash-filled ground
New Brunswick	Concrete	5—6	Brick or Asphalt	No		Yes	Ditches for sewer, water or gas
Ridgefield Park	Broken Stone	4	3 in.			Yes	Wet clay soil—improperly drained—considerable traffic
Rutherford	Broken trap & Concrete	4½	2 -1½ in. with "C" grade Asphalt	No	Auto trucks, 2 to 6 tons probably 2,000	Yes	Red clay in bottom 14 in. cut
New York:							
Binghamton	Concrete	6	Brick	No		Yes	Pipe trench
Buffalo	Natural Cement Concrete	6	Asphalt	Yes		Yes	Drains each side—but not sufficient
Corning	Concrete	6	Brick	No	Motor trucks and pleasure cars, maximum weight 6 tons	No	From the deterioration of gravel used in concrete base
Gloversville	Concrete	5—6	Vit. Brick	Yes		Yes	
Herkimer	Concrete & Crushed stone	4—5	2 in.	No		Yes	Sewer trenches
Manhattan	Concrete	6	Asphalt, Granite & Wood	Yes		Not usually	Water leaks washing materials into bad filling elsewhere
Niagara Falls	Concrete	4		Yes		Yes	Pipe trenches and heavy traffic
Ogdensburg	Concrete	6	Brick	No		Yes	Trenches filled with clay
Oneonta	Concrete	6	Brick	No		Yes	

BASE AND SUBGRADE FAILURES—(Continued)

City and State	What kind of pavement base has failed?	Thickness of base, inches	Wearing surface	Was failure due to traffic?	Description of traffic	Was failure due to yielding of subgrade?	Cause of yielding
North Carolina:							
Durham	Concrete	6	3 in.	No		Yes	St. Ry. Co.'s faulty track construction
Fayetteville	Gravel & Clay	9	Durax blocks				
Statesville	Concrete	4	2½ penetration Tarvia Macadam	No		Yes	Base was laid with lap joints and they telescoped
Wilson	Concrete	4		Yes	Heavy trucks	Yes	Pipe trench—probably bit; base too light for traffic
Ohio:							
Akron	Crushed Slag & Sand	6	Brick	Yes	Heavy hauling	Yes	Clay soil—no drainage; hauling with trucks while soft
Alliance	Gravel	6	Asphalt Blocks 4 in.	Yes	10-ton trucks 400 to 500 total of vehicles	Yes	Lack of drainage with poor base
Bucyrus	Rolled Stone	6	Brick	No		Yes	Lack of drainage
Chillicothe	Concrete	5—6	Brick & Asphalt Block	Yes	Very heavy		Lack of thorough compaction of trench
Delaware	Concrete	6—4	Brick & Asphalt Block	No		Yes	Embankment on brick and pipe trench on asphalt
Lakewood	Rolled Cinders	6	4 in. Brick	Yes	Occasional 10-ton trucks	Yes	Most failures over improperly placed fill in old trenches
Lancaster	Rolled Gravel	6	Brick	No		Yes	Due to sewer trenches—backfilling carelessly done and sub-grade not properly rolled Trenches
Lorain	Concrete	6	Asphalt	Yes		Yes	
Marietta	Sand & Gravel		Brick	Yes	Trucks	Yes	
Marion	Rolled Stone	8	Brick	Yes		Yes	
Norwalk	Concrete	6	Brick	No		Yes	Lack of drainage
Wooster	Stone	1	Brick			Yes	Local stone used in foundations gave way—may not have been properly tamped
Zanesville	Gravel	6	Brick			Yes	Lack of drainage
Oklahoma:							
Durant	Concrete	4	Asphalt Macadam	No		Yes	Lack of drainage "alkali" soil
Oregon:							
Astoria	Crushed rock, Concrete	5—6	Bitulithic	No		Yes	Slides and settlement due to excessive rain-fall and to foundation which is mostly soapstone
Corvallis	Port. cement Concrete also Black base	4	Asphaltic Concrete	Yes		Yes	Lack of drainage
Eugene	Black & Concrete	3½—4	1½ in. Bit. & Sheet Asphalt	Yes	quite heavy	Yes	Lack of drainage and lack of thickness and quality in concrete base
Pennsylvania:							
Allentown	Concrete	4	1 in. Binder, 1½ in. asphalt	Yes		Yes	Trenches
Altoona	Concrete	6	Brick & Sheet Asphalt			Yes	Trenches and insufficiently rolled subgrade; inadequate drainage
Chester	Concrete	6	2 in. Sheet Asphalt	Yes	heavy commercial	Yes	Pipe trench
Dormont	Concrete	5	Brick, Sand Cushion	Yes	Sand and material trucks, gross weight about 25,000	No	Some failures due to new or not sufficiently rolled embankment
Duquesne	Gravel	8	Brick	Yes			
Easton	Concrete	5	Brick	Yes		Yes	Yielding of sub-soil after concrete became shattered due to inferior concrete
Monongahela	Slag, Gravel	7	Brick	Yes	Motor trucks	Yes	Sewer and other street openings
Norristown	Concrete	4—5	Vitr. brick	No	Quite heavy	Yes	Pipe trenches and by leaking water mains and services, surface water freezing; disintegrating surface pavement
Rankin	Gravel & Sand	6 gravel 2 sand	Brick	Yes	3,600 heavy trucks and pleasure cars	Yes	lack of drainage—foundation not strong enough for heavy trucks
Sharon	Gravel & Slag	3—6	Brick, conc. & Asph. Block	Yes		Yes	As block pavements wear out because of blocks wearing—base good
Tyrone	Concrete	6	Vitrified Brick	Yes	Trucks carrying stone for highway contractors	No	Disintegration of concrete
Uniontown	Crushed Stone	6—8	Brick	Yes	Heavy trucks, hauling coal, weigh from 3 to 15 tons	Yes	Mostly pipe trenches, some due to improper drainage
Rhode Island:							
Bristol	Clay	3	Tar Concrete	No		Yes	Lack of drainage

BASE AND SUBGRADE FAILURES— (Continued)

City and State	What kind of pavement base has failed?	Thickness of base, inches	Wearing surface	Was failure due to traffic?	Description of traffic	Was failure due to yielding of sub-grade?	Cause of yielding
South Carolina:							
Greenville	Concrete	3	Asphalt	Yes			Base too thin—car tracks not properly laid
Union	Concrete	4	1 in.				
Texas:							
Amarillo	Vibrolithic	7	Vit. Concrete	No		No	Lack of sufficient expansion joints
Brownwood	Clay or soil		8 to 10 in.	No		Yes	No proper foundation
Clarksville	Waterbound Macadam	6	Asphalt penetration, 2 in.	No	400 autos; 100 wagons and buggies	Yes	Lack of drainage
Corpus Christi	Concrete	4—5	Bitulithic	No		Yes	Black gumbo sub-soil
Greenville	Concrete	4	Brick & As. Concrete	No		Yes	Water main leaks subsequent settlement
Longview	Macadam	8	Asphalt Macadam Asphaltic	No		Yes	Lack of drainage
Waxahachie	Concrete	5	Concrete 2 in.	No		Yes	Black land foundation over limestone. Under ground water running on top of limestone
Port Arthur	Concrete	4	2 in. Asphalt	No			
Temple	Concrete	5	2 in. Asphaltic Concrete	No		Yes	Gaps in pavement allowed water to get in under base
Virginia:							
Danville	Crushed Stone	6	Brick	No		Yes	bursting of water mains and caving of under ground store-water drains
Newport News	Concrete	8	Concrete	No		Yes	Lack of drainage
Norfolk	Concrete	4—5	1½ binder 1½ in. top Asphalt	Yes	Motor trucks, 10 to 15 tons	Yes	Pipe trenches
Washington:							
Chehalis	Concrete	6	Brick		750 vehicles a day, max. weight 15 tons	Yes	Sewer trench not settled prior to paving
Olympia	Concrete	4	2 in.			Yes	Pipe trench and lack of drainage
Walla Walla	Bit. & Port. Cem. Con.	2½—4	Bitulithic & Sheet Asphalt	No		Yes	Settlement of trenches
West Virginia:							
Fairmont	Concrete	5	Brick	No		Yes	Pipe trenches badly back-filled
Wisconsin:							
Racine	Concrete & Crushed stone	5—6	Brick	Yes	Trucks over 12 tons	Yes	Pipe trenches under concrete and softening of crushed stone when frost comes out in spring
Sheboygan	Concrete	6	Brick	No		Yes	Large drainage of soil underlaid with quicksand hard to drain sufficiently to prevent heaving from frost under low temperatures
Superior	Concrete	5	Creo. blocks & Asphalt	Yes	Heavy trucks	No	Weak concrete base
Waukesha	Hyd. Cement Concrete	4—6	Brick	Yes	Motor trucks	Yes	Pavement sunk over trenches due to sub-soil being gravel and hard to get into shape
Wis. Rapids	Concrete	6½	Concrete	No		Yes	Lack of drainage

Failures of Pavement Bases

Causes of failures in several hundred cities. Sub-grade more commonly responsible than traffic. Sixty per cent of cities had no base failures.

The opinion is growing that more pavement failures than was formerly realized are due to the base rather than to the wearing course. Most wearing courses are poorly adapted to performing the functions of a base or foundation and if the base or subsoil under them fails, the wearing course must fail also.

In order to obtain some information on this subject, covering the various conditions found throughout the country, we included in a recent questionnaire sent to city engineers, certain inquiries concerning failures of pavement bases in their respective cities. Of the first 460 replies received to these and other questions, 139 failed to reply to the questions concerning base failures. Of the 321 who replied, 196 reported that no pavement bases had failed in their cities. The data given by these replies have been tabulated, the tables being published in this issue.

The following information on this subject has been obtained by summing up the tabulated data and also from supplementary explanations given on the returned questionnaires.

Of the various bases reported upon, 87 were concrete, 3 were bituminous concrete, 29 were macadam or gravel, 2 were slag and 3 were sand and 1 was brick.

The informants were asked to state whether the

CONCRETE BASE UNDER ASPHALT BLOCK (BOSTON POST ROAD, NEW YORK) DESTROYED FOLLOWING SOFTENING OF SUB-GRADE BY SPRING THAW

pavement had failed because of traffic or because of a yielding of the sub-soil. Of the concrete bases 49 were reported as having yielded because of sub-soil, 8 because of traffic, 5 because of poor construction of the base, and 25 because of combinations of these. If we combine failures due both wholly and partly to each of the several causes, we find 73 from soil weakness, 32 from too heavy traffic and 7 from poor construction, percentages of 66, 28 and 6 respectively. Of the bituminous concrete, one failure was reported due to soil alone and two to both soil and traffic. Of the macadam and gravel roads the soil was responsible for 13 failures, traffic for 3, and 13 were due to a combination of these and poor construction. Combining these as above, we find 25 due to soil, or 60 per cent; 14, or 33 per cent, due to traffic; and 3, or 7 per cent, due to poor construction. Of three cities reporting sand base failures, two reported such failure due to sub-soil and one to traffic. Of the two slag bases, one failed because of traffic and the other because of both traffic and sub-soil. The one failure of brick base was reported due to a combination of traffic and sub-soil.

Combining all of the failures of the various kinds of pavement, we find 104 due to sub-soil, 51 to traffic and 10 to poor construction.

Of the failures attributed to the sub-soil, the majority were on account of the settling of the backfilling of trenches. In some cases the streets had been laid upon embankment which continued to settle. Several of the cities, chiefly in the southwestern part of the country, referred to the phenomenon of excessive shrinking of the gumbo soil, which sometimes opens up cracks two inches or more wide, the tendency of which is of course to crack open the base immediately above such cracks in the sub-soil.

Second only to pipe trenches as a cause of failure of the sub-soil was poor drainage of wet soils. One city engineer in Kansas who attributed failure to "shrinkage of gumbo sub-soil" adds that "Recent paving has not failed. We use more care and lay mostly 5-inch base. Through some base I have laid a reinforcing rod transversely each 30 feet." In this city the base which was reported to have failed was 4-inch concrete.

A Pennsylvania city reported a brick pavement on a 5-inch concrete base to have failed because of the joint between the base and the combination curb and gutter; also that some failures had been due to embankments which had not been sufficiently rolled.

Several engineers explained the freedom of their pavement bases from failure. For instance, one North Carolina city engineer stated: "The entire city is underlaid with sand, forming an ideal natural foundation. The brick pavement is mostly 18 years old, on sand foundation with cement grout, and except where it has been cut is in as good condition as when it was put down. The asphalt macadam has been down 10 years and is good for about one year more." In this city both brick and asphalt macadam were laid on the natural sand soil. A Connecticut city engineer writes: "The sub-soil drainage in this city is excellent, in view of which we are able to resurface old macadam pavements with sheet asphalt (1½ inch binder, 1½ inch top) with gratifying results." Another Connecticut engineer writes, "I have used 2½-inch to 3-inch broken stone bases bound with sand on heavy traffic streets with 2½-inch to 3-inch asphalt macadam stone on sand and clay sub-base and have never had a failure. The failure in many places is due to poor drainage and small crushed stone for the base."

The general impression given by the various replies is that failure of pavement bases is due to traffic in not more than one-third or one-fourth of the cases of failure, most of the balance being due to failure of the sub-soil either over imperfectly compacted trenches or because of yielding due to poor drainage. This general statement seems to apply to each class of base. The concrete, for which is claimed the advantage of bridging over small areas of yielding sub-soil such as trenches and wet spots, is reported to yield under such conditions in as high a percentage of cases as macadam or any other type of base.

Of the 335 cities that did not report any failures of bases, a number gave no statement on the subject, but 121 reported that there had been no failures of bases. Absence of failures was reported for 84 pavements having concrete base, 2 having asphalt concrete, 20 having macadam, 7 having gravel, 5 having sand, 1 cobblestone, and 2 with no base except hard soil.

Of the 84 pavements with concrete base that have not failed, 34 had rigid surfaces such as brick or granite block, while the remaining 50 were surfaced with sheet asphalt, bituminous concrete, and other pavements similarly adapted to cushioning the impact of traffic.

Macadam base was used under brick in two cases, and in the remaining 18 cases under bituminous macadam and bituminous concrete.

One New York city reports that the only base to fail on its streets was that of a state-built brick pavement on concrete, which failed over trenches that had recently been dug and not properly backfilled. The concrete base was reinforced with ¾-inch lug bars laid crosswise of the trenches, but these apparently were not effective. "Might better have spent the money drawing away the soggy clay to a dump and filling the trenches with old dry macadam or sand or cinders."

One Kansas city engineer stated that the contraction and expansion of a 5-inch concrete base caused

(*Continued on page* 137)

PUBLIC WORKS.

Published Weekly
by
Municipal Journal and Engineer Inc
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba....$3.00 per year
All other countries .....$4.00 per year

Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

CONTENTS

NON-RIGID BASES FOR PAVEMENTS—Illustrated—By Prevost Hubbard 111
THE ILLINOIS EXPERIMENTAL HIGHWAY—Illustrated—By Prof. Charles Carroll Brown 115
STREET PAVING IN GOLDSBORO—By W. A. Hardenbergh 118
REINFORCING CONCRETE PAVEMENT 119
STREET WORK IN PORT ARTHUR 120
LABOR FOR PUBLIC WORKS—Illustrated 121
UNSKILLED LABOR IN THE UNITED STATES—Table 122
BASE AND SUB-GRADE FAILURES—Table..... 130
FAILURES OF PAVEMENT BASES—Illustrated.. 133
EDITORIAL NOTES 135
Labor in 1921—City Streets and Highway Pavements—Pavement Basis
Our Tabulated Pavement Data 137
State Manufacture of Road Materials 137
Failures of Pavement Bases 137
Reinforcing Concrete Pavements 137
Alabama's Highway Bonds 137

Labor in 1921

There will be plenty of unskilled labor in all parts of the United States for carrying out all of the public work contemplated by the cities of the country this year, and in general the wages will be very materially lower than they were a year ago.

Of the above there would seem to be no possible doubt. It is not the opinion of one man or of a dozen men, but of six hundred city engineers distributed over the entire country from Maine to Florida, throughout the Mississippi valley, across the Rockies and on the Pacific coast. Six hundred city engineers have reported to us during the past six weeks, each concerning conditions in his own district, and more than 93 per cent stated positively that there would be plenty of labor for public works this year, and only eight of the remainder reported that there would not be plenty, the others being in doubt.

With such almost absolute unanimity of opinions coming from all parts of the country, and from men who are intimately connected with public works in their respective cities, occasional errors of judgment are buried in the general concensus of opinion. If there are a dozen or so cities where more laborers are needed, the deficiency can certainly be made up from the hundreds of other localities where they are found in abundance.

As to wages, in most localities these have already lost 50 to 75 per cent of last year's increase above pre-war rates and indications are that they will fall still lower. In fact, in some localities they have already almost reached pre-war conditions.

With satisfactory conditions as to labor, and with plenty of funds available, any restriction on public work this year will apparently be due to scarcity or high prices of materials. There would seem to be little, if any, need for the former, with abundance of labor and the railroads in condition to handle a considerable increase of traffic. It is certainly to be hoped that the manufacturers and the dealers in materials used in public work will not make themselves responsible for putting the brakes on progress in such work this year by adopting or maintaining a selfish or short-sighted policy of profiteering prices. It is also to be hoped that engineers and others in charge of public works will meet such condition, should it occur, by substituting materials offered at more reasonable prices where it is possible to do this by modifying their plans or changing types of construction.

City Streets and Highway Pavements

With the increasing use of heavy trucks over county and state highways, the wheel loads to be supported by highway pavements are probably as great as those to which the majority of city pavements are subjected; while the more popular highways carry as intense traffic as almost any city street, per foot of width. As far as traffic conditions are concerned, therefore, there would seem to be no reason for differentiating between highways and city streets in paving practice.

In the support furnished to the pavement, however, there are several features of difference. Although the same kind of soil is found in both city and country, highways have occasionally to cross swampy lands which would not be used as building sites; also city streets generally contain sewers and water mains, and frequently gas mains, wire conduits and other structures laid in continuous lines under the street surface; while the houses along the street are generally provided with cellars whose bottoms are carried lower than the street level, except in those southern states where cellars are the exception. The continuous trenches in which the underground conduits are laid serve as blind drains in the majority of cases, removing any underground water that may reach them unless it is in enormous amounts; while cellars aid in drying out the subsoil down to the level of their bottoms, either by direct action or because water in the sub-soil surrounding them cannot be tolerated and must be

removed by artificial drainage. We therefore find wet sub-grade much less common in city streets than in country highways.

Trenches, however, are objectionable in that settling of the backfilling (which is very difficult to prevent) removes the support offered by the sub-grade to the pavement, which must then either bridge over the settled area or settle in its turn and damage the pavement.

The above takes into consideration only the more self-evident points, and various local conditions will necessitate more or less important modifications of the conclusions drawn. Such conclusions, however, may be stated as follows:

On the more important highways, the same wearing surface should be used as for main city streets.

In city streets where trenches have been or will be dug, a base should be used that is able to carry the traffic by bridging over such trenches, or else special precautions should be taken to make the backfilling even more solid than the undisturbed soil.

On highways or streets not trenched, bridging ability is not so important, since the sub-base is presumably fairly uniform in supporting power. This supporting power, however, should be made the maximum possible by drainage to remove sub-soil water, by rolling to compact it, and occasionally by the use of clay, sand, gravel or other materials whereby added stability may be given to the surface.

In general, the main differences between the two classes of roads, so far as pavements are concerned, are due to the presence or absence of trenches, and to the relative freedom from ground water, which generally lowers the supporting power of the sub-grade.

Pavement Bases

Does the average paving official give sufficient consideration to the matter of pavement bases? One such official is quoted as having recently made the sweeping statement that every good pavement either consists of concrete or has a concrete base, and a great many paving engineers and others seem to assume this is axiomatic.

Another engineer has said that a clay road will give as good satisfaction under even the heaviest traffic as any kind of pavement, provided it is kept continually dry. Still other engineers have said that 90 per cent of the pavements laid would give better service at less cost if placed on a bituminous base rather than on cement concrete.

We believe that every unprejudiced engineer of wide experience will admit that the last two statements contain at least an element of truth; and yet in the great majority of cases, to an engineer deciding upon the character of a pavement, no question suggests itself as to what is the best base—he merely wonders if he can afford or the traffic justifies a concrete base, or whether he must lay the pavement without any base.

The entire load of traffic is carried by the sub-grade—the base merely transmits and distributes it. If the sub-grade has such bearing power throughout that the traffic, if carried directly upon it, will not cause appreciable depression in the surface, and if it is certain that the sub-base will retain this condition under all conditions of weather, there is no need of a base, and very little need of a wearing course other than one sufficient to prevent abrasion and dust. Pavements laid on such soil without a base twenty or thirty years ago are still in good condition.

If the sub-base is incompressible throughout, but composed of particles which may flow under localized pressures, such as dry sand, the chief function of a base is to prevent such movement of particles by distributing the pressure over larger areas and also by preventing a rising of particles above the general level when displaced by corresponding depressions under the loads applied.

Where the supporting power of the soil is not uniform, but there are small areas that would yield under pressure, the chief function of the base is to bridge over these spots and transmit the load to the more solid portions of the sub-grade surrounding them, like a floor slab supported at the edges.

Where the entire sub-grade is, or may become during wet weather, without sufficient supporting power to sustain the traffic loads without yielding unless such loads be distributed over considerable areas, it is the function of the base to so distribute the loads. In this case the slab acts much as a raft supporting a load in water, and if the soil becomes very soft the flexible base develops waves and hollows, the rigid one breaks into innumerable pieces; in either case the pavement is ruined.

In rolling a sub-grade there are very apt to be left spots somewhat less compacted than others; in fact, it is hardly practicable to obtain absolutely equal compaction over the entire area of a sub-grade. If a rigid base be employed, the areas of less compactness do not support their share of the load imposed by traffic, but the base over them must act as a floor to transmit this to the firmer soil around them. In many cases, however, if the base could yield a quarter or even an eighth of an inch, these spots would then develop as great a supporting power as the surrounding area, and the base would no longer need to exert bridging action. In the case of a flexible base, such as asphaltic concrete, this is what happens. The slight depression of an eighth of an inch necessary to establish uniform support throughout the sub-grade does not produce a defect in the pavement nearly so serious as that occasioned by a break in a rigid concrete base; and yet such a break occurs if the load applied to the rigid base over such weak spot in the sub-grade is greater than the base can support as a slab.

It follows from this that the beam strength of a non-rigid pavement does not need to be nearly so great as that of a rigid pavement in order to secure equal effectiveness of the base in performing its function.

There are other conditions under which the adaptability of the flexible base to minor sub-grade changes is of great advantage; for instance, in the case of a pavement built upon an embank-

ment which continues to settle slightly, not enough to throw the pavement objectionably out of surface but great enough to cause cracks in a rigid pavement.

On the other hand, rigid pavements are advantageous where narrow areas of depression occur in the sub-grade over which a flexible base would continue to settle for an inch or more before coming to rest, and so produce undesirable depressions in the pavement surface; while these areas, if sufficiently narrow, are bridged by a concrete base of reasonable thickness. A common illustration is that of narrow trenches, such as those for house connections, which are often bridged successfully by 6-inch or 8-inch concrete bases.

The above is merely a superficial consideration of the subject, but it is by no means purely theoretical or at all imaginary. Millions of yards of flexible base much thinner than is generally employed for rigid bases have successfully supported for years pavements carrying heavy traffic. On the other hand, it is probable that very few concrete pavements or concrete bases can be found that do not contain hundreds of lineal feet of cracks in every mile of pavement caused by the non-uniformity of the supporting power of the sub-grade.

No attempt is made in the above to even indicate exactly under what conditions rigid base, non-rigid base, or no base at all should be employed, but only to call attention to the fact that there is a question to be considered, and a serious one which involves the saving or wasting of millions of dollars every year in the construction of pavements in this country.

Our Tabulated Pavement Data

For more than a dozen years we have published about this time each year data concerning paving in American cities, obtained through the kind co-operation of hundreds of city engineers. This year the question uppermost in the minds of paving authorities is whether enough labor for all the paving work contemplated can be obtained, and at what wages. On the technical side, the question of bases is assuming the most prominent place. On both of these subjects we have collected data which are presented in this issue. Figures as to the amount of pavement laid in several hundred cities have been tabulated but are postponed to future issues for lack of space in this.

State Manufacture of Road Materials

Kansas good roads boosters claim that there is in that state a combine of dealers in road materials which is holding up prices of such materials, and they are asking the state legislature to enact a law authorizing the state to own and operate plants for manufacturing cement and brick. It is believed that such a law would be legal under the constitutional amendment adopted last fall authorizing the state to aid in the construction of state highways. The advocates of such an act also are considering submitting to the voters a constitutional amendment that would authorize the state to sell road materials so manufactured when these should exceed the demand for state purposes.

Failures of Pavement Bases

(*Continued from Page 134*)

cracks which allowed the sand cushion under brick pavements to flow out into the cracks, causing the brick to settle.

Owensboro, Ky., reports that there were no failures of either concrete or macadam base pavements, as all the streets are sub-drained along the curb. On the other hand, Buffalo, N. Y., reports that drains along each side of the pavement were not sufficient to prevent settlement of the 6-inch concrete base due to a yielding of the sub-soil. One Ohio engineer reports that brick pavements laid on about one foot of stone for a base had failed in places, probably because the stone base had not been properly tamped.

Reinforcing Concrete Pavements

The figures for the 150 cities whose reports have been tabulated for this issue show nearly 2,000,000 square yards of concrete pavement built last year, and of this 35 per cent contained reinforcement. By far the largest part of the reinforcement used in the concrete pavements is in the form of fabric rather than bars. A number of engineers reported their intention to use reinforcement in 1921 construction, and all but three of these stated their intention of using fabric, and one of the other three said that bars "probably" would be used.

By far the largest part of the fabric used in these cities weighs between 25 and 35 pounds per 100 square feet of pavement, 28 and 30 pounds appearing to be most popular. About 78 per cent reported use of fabric weighing between 25 and 35 pounds, both inclusive; about 14 per cent reported 40 pounds, the balance being evenly divided among 42, 50 and 100 pounds. In addition, one city reports main members .08 square inch, 6 inches apart. Another reports .058 square inch, spacing not stated. One city uses 32 pounds of fabric in each of two layers, making 64 pounds per 100 square feet.

Alabama's Highway Bonds

On February 16, 1920, the voters of Alabama authorized a bond issue of $25,000,000 for constructing a permanent system of roads in that state. A question having been raised as to the validity of the bonds because of a point of legal procedure in connection therewith, a friendly suit has been started and briefs for and against the validity of the bonds have been prepared for submission to the Supreme Court in order that the point may be authoritatively and finally settled to the satisfaction of all possible purchasers of the bonds.

NEWS OF THE SOCIETIES

Feb. 7—PORTLAND, OREGON SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

Feb. 7-8—FLORIDA ENGINEERING SOCIETY. Annual meeting. Lakewood, Fla.

Feb. 8—BOSTON SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Feb. 8—BOSTON SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Feb. 9—THE NEW ENGLAND WATER WORKS ASSOCIATION—February meeting Copley Square Hotel. Boston. Secretary F. H. Gilford, Dedham, Mass.

Feb. 9-12 — AMERICAN ROAD BUILDERS' ASSOCIATION. Eighteenth annual convention, eleventh American Good Roads Congress and twelfth National Good Roads Show, Coliseum, Chicago, Ill.

Feb. 10—SOCIETY OF AUTOMOTIVE ENGINEERS, Hotel New Southern, Columbus, O.

Feb. 11—LOS ANGELES SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Feb. 11-12 — ENGINEERING SOCIETY OF WISCONSIN. Annual meeting, Madison. Secretary, Leonard S. Smith, Madison, Wis.

Feb. 14—AMERICAN ENGINEERING COUNCIL. Technology Club, Syracuse, N. Y. Headquarters at Onandago Hotel.

Feb. 14-16 — NATIONAL CIVIC FEDERATION. 21st annual meeting, Hotel Astor, New York.

Feb. 14-16 — AMERICAN CONCRETE INSTITUTE. Annual meeting. Auditorium Hotel, Chicago, Ill. Secretary, Harvey Whipple, New Telegraph Building, Detroit, Mich.

Feb. 15 — BUFFALO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Feb. 15—COUNCIL OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Technology Club, Syracuse, N. Y.

Feb. 15-17 — PROVINCIAL ASSOCIATION OF CONTRACTORS AND SUPPLY DEALERS OF ONTARIO. Startford, Ont.

Feb. 16-18 — AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Seventh midwinter convention. Engineering Societies' Building, New York City.

Feb. 21-23 — MINNESOTA SURVEYORS' AND ENGINEERS' SOCIETY. Annual convention. Hotel Commodore, St. Paul.

Feb. 23—NEW YORK SECTION, AMERICAN SOCIETY OF CIVIL ENGINEERS. Meeting postponed from Feb. 16.

Feb. 25-26—CONSTRUCTION DIVISION, U. S. ARMY. Annual reunion of those identified with this division during the war. Morrison Hotel, Chicago, Ill.

Feb. 28 — PHILADELPHIA SECMECHANICAL ENGINEERS. Engineers' Club of Philadelphia.

Feb. 28 — CHICAGO SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

March 11-12 — NORTHWESTERN ASSOCIATION OF GENERAL CONTRACTORS. St. Paul Hotel, St. Paul, Minn.

March 14—AMERICAN ASSOCIATION OF ENGINEERS. The third annual railroad conference. Chicago.

April 27—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention. Houston, Texas.

April 27-29—UNITED STATES CHAMBER OF COMMERCE. 9th annual meeting. Atlantic City, N. J.

May 9-11 AMERICAN ASSOCIATION OF ENGINEERS. 7th annual convention. Buffalo.

May 17-19—NATIONAL FIREMEN'S ASSOCIATION. Twenty-third annual convention. Fort Wayne ,Ind.

June—CONFERENCE OF MAYORS AND OTHER CITY OFFICIALS, State of N. Y. 12th Annual Conference. Elmira, N. Y.

June 6-10—AMERICAN WATER TER WORKS ASSOCIATION. Annual convention at Cleveland, Ohio. Secretary, J. M. Diven, 153 West 71st St., New York.

June 7-9—NATIONAL FIRE PROTECTION ASSOCIATION. Annual meeting, San Francisco, Cal.

Oct., 1921—IOWA SECTION, AMERICAN WATER WORKS ASSOCIATION. Seventh annual meeting.

AMERICAN ENGINEERING COUNCIL

On February 14, the executive board of the American Engineering Council of the Federated American Engineering Societies will hold sessions at Syracuse, N. Y., culminating in the evening in an address by Herbert Hoover, who will outline the new council's plans for dealing with industrial relations and particularly with human waste as it affects the present army of unemployed.

Mr. Hoover will urge co-operation with Congress, with labor organizations, chambers of commerce and other bodies in the campaign planned by the council to remedy economic ills.

On February 15, the national council of the American Society of Mechanical Engineers will convene at the same place. This society has placed its resources and membership of 13,000 behind the movement to federate the country's engineering skill under the headship of Mr. Hoover with the American Engineering Council as the spokesman, who will work "to get America's idle back to work, and keep it at work."

The Syracuse meetings will bring together engineers from every industrial center in the country. Delegations will go from New York, Albany, Utica, Buffalo, Rochester, Schnectady, Troy and other cities. The engineering societies of Chicago, Cleveland, Boston, St. Louis, Pittsburgh, Detroit and other places will be represented by officials of the two councils.

On the board of the American Engineering Council the American Institute of Electrical Engineers is represented by Calvert Townley of New York, vice-president of the Westinghouse Co.; the American Institute of Mining and Metallurgical Engineers by J. Parke Channing of New York; the American Society of Mechanical Engineers by Dean Dexter S. Kimball of Cornell University, and the Associated Engineering Societies of St. Louis by William E. Rolfe. These four, as vice-presidents of the council, are actively assisting Mr. Hoover in framing

As a result of a report submitted to the council by Mr. Hoover, the council will probably encourage the formation of state engineering councils, a process already under way in many states, including Massachusetts and Minnesota. A federation of New York state engineers, it is said, is a probability of the near future.

THE ELEVENTH ANNUAL AMERICAN GOOD ROADS CONGRESS AND SHOW

The eleventh annual American Good Roads Congress and twelfth National Good Roads Show, under the auspices of the American Road Builders' Association, will be held at Coliseum, Chicago, February 8, 9, 10, 11 and 12.

TENTATIVE PROGRAM

February 8, 8 p. m., formal opening of twelfth national Good Roads Show, Coliseum.

February 9, 9 a. m., registration of delegates.

Convention Hall, Coliseum, 10 a. m. —Announcement of convention committees. H. L. Bowlby, Chief War Materials Division, U. S. Bureau of Public Roads, Washington D. C., presiding. "Our National Road Problems," Thomas H. MacDonald, Chief, U. S. Bureau of Public Roads, Washington, D. C. "Relations of the Highway and Motor Transport Movement to Education," Prof. C. J. Tilden, National Director of Highway and Highway Transport Education, Washington, D. C. "Highway Improvements in New England," A. W. Dean, Chief Engineer, Division of Highways, Massachusetts Department of Public Works. "The Local and National Importance of the Lee Highway," Dr. S. M. Johnson, Manager, Lee Highway Association, Roanoke, Va.

Convention Hall, Coliseum, 2 p. m. —George C. Diehl, county engineer, Erie county, N. Y., presiding. "The Highway's Part in the Development of Efficient Transportation," C. W. Reid, Chairman, Transportation Committee, Federal Highway Council, Washington, D. C. Discussion, T. J. Wasser, State Highway Engineer of New Jersey, and others.

Mass Meeting, Medinah Temple, 8 p. m.—Michael J. Faherty, President, American Road Builders' Association, presiding. Musical program. Address of welcome on behalf of the city of Chicago, Hon. William Hale Thompson, mayor of Chicago. Response on behalf of the American Road Builders' Association, by Michael J. Faherty, president. "Good Roads Movies."

Convention Hall, Coliseum, February 10, 10 a. m.—C. M. Upham, Chief Engineer, Delaware State Highway Department, presiding. "Sub-grades," H. G. Shirley, Secretary, Federal Highway Council, Washington, D. C. Discussion, Clifford Older, Chief Highway Engineer of Illinois, and others. "Importance of Drainage in Road Construction," F. H. Eno, Professor of Engineering, Ohio State University. Discussion by H. S. Mattimore, Assistant Engineer, Pennsylvania State Highway Department, and others.

Convention Hall, Coliseum, 2 p. m. —J. A. Duchastel, City Manager, Outremont, Canada, presiding. "Types of Pavements," James H. MacDonald, former State Highway Commissioner of Connecticut, New Haven, Conn. Discussion, Newell D. Darlington, Chairman, California State Highway Commission; Herbert Nunn, State Highway Engineer of Oregon, and others. "Highway Researches and What the Results Indicate," A. T. Goldbeck, Chief, Division of Tests, U.

S. Bureau of Public Roads, Washington, D. C. Discussion, Anson W. Marston, Dean, Iowa State College, and others.

Evening Entertainment — Dinner-dance at the Congress Hotel.

Convention Hall, February 11, 10 a. m.—Frank F. Rogers, State Highway Commissioner of Michigan, presiding. "Recent Developments in Road Building," Edward N. Hines, Chairman of Board, County Commissioners, Wayne County, Mich. Discussion, W. D. Uhler, Chief Engineer, Pennsylvania State Highway Department; R. Keith Compton, Chairman, Baltimore Paving Commission, and others.

Convention Hall, Coliseum, 2 p. m. —Howard F. Beebe, President, Harris, Forbes & Co., New York City, presiding. "Highway Finance," H. C. Sylvester, Vice-President, National City Co., New York City. Discussion, S. E. Bradt, Superintendent of Highways, Department of Public Works and Buildings, Springfield, Ill.; H. P. Gillette, Editor, *Engineering and Contracting*, and others.

Evening Entertainment — Theater party at two of Chicago's leading theaters.

Convention Hall, Coliseum, February 12, 10 a. m.—Walter A. Rogers, of Bates & Rogers, Chicago Ill., President, Associated General Contractors, presiding. "Relation Between Engineers and Contractors," W. A. Rogers, President, Associated General Contractors. Discussion, R. G. Collins, Keystone Construction Co.; A. R. Hirst, State Highway Engineer of Wisconsin; D. A. Garber, President, Northeastern Construction Co., New York City, and others.

Convention Hall, Coliseum, 2 p. m.—Question box, report of resolutions committee, election of nominating committee.

As many women will be present, special entertainment features have been provided for their benefit, including a reception and tea, February 9, at the Congress Hotel; a sightseeing tour by automobile, followed by a luncheon and entertainment at the Drake Hotel; a shopping tour; a luncheon at the South Shore Country Club, and dinner and dance at the Congress Hotel.

THE NEW ENGLAND WATER WORKS ASSOCIATION

The annual meeting of the New England Water Works Association was held on January 12 at the Copley Square Hotel, Boston, Mass. The executive committee met in the morning at the association headquarters, the Tremont Temple, and luncheon was served later in the hotel.

The following officers were elected for the ensuing year: President, Charles W. Sherman; vice-presidents, Frank A. Barbour, Percy R. Sanders, William W. Brush, Reeves J. Newsom, Patrick Gear and George A. Carpenter; additional members of the executive committee: David A. Heffernan, James A. Newlands and Arthur A. Blackmer; secretary, Frank J. Guffird; treasurer, Lewis M. Bancroft; editor and advertising agent, Henry A. Symonds; and finance committee, George H. Finneran, A. R. Hathaway and Frank A. Marston.

A report was then read by the retiring president, Henry V. Macksey, which showed the association to be in sound financial condition and advancing along progressive lines. Secretary Frank J. Gifford reported the present membership as numbering 872 persons, consisting of 14 honorary members, 788 active members and 70 associate members. This was followed by a short speech by the new president, prophesying a prosperous year for 1921.

AMERICAN CONCRETE INSTITUTE

A session on contractor's plant, February 15, 8 p. m., will receive the report of the special committee on contractor's plant in reinforced concrete building construction. A survey of the concrete road building situation indicates that while many contracts were not completed last year, leaving a balance of uncompleted contracts of 33,000,000 square yards, 1920 was the biggest year in actual yardage put down that we have had and 1921 will probably eclipse that record. An address by F. M. Ballsley of the Wisconsin State Highway Department on Equipment for Concrete Road Construction has been prepared after a survey of many jobs in several states.

A paper by C. R. Ege is on Developments in Construction Plant and Crew Organization in Concrete Road Work.

A. C. Irwin will present a compilation of small bridge and culvert standards as used at this time in many cities.

A meeting of the Committee on Concrete Roads, Clifford Older, chairman, will probably be held during the convention.

Concrete products manufacturers will have a special session February 16, at 2 p. m., and will present the revised standards for building units.

J. W. Lowell, of the Universal Portland Cement Co., will present a paper on Coloring Concrete.

J. C. Pearson, chairman of the Committee on Concrete Surfaces, will present a report outlining important work to be undertaken by that committee.

Mr. Pearson will also present a paper on the Shrinkage of Portland Cement Mortars, with Special Reference to Stucco.

The changing situation with regard to lumber supply for form work has prompted President Turner with the authorization of the Board of Direction to appoint a special committee on Steel Forms.

The Committee on Reinforced Concrete Chimneys, J. G. Mingle, chairman, proposed to submit a set of standards for the design and construction of reinforced concrete chimneys. "Our idea will be to make up the specifications in such a manner that they will be of use to the average man and the architect and engineer rather than try to get the different chimney companies to adopt the same proposal form. It will be short and concise to set forth the best practice in design and construction."

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

On February 2, the Ontario section of the A. S. M. E. held a joint meeting with the annual meeting of the Engineering Institute of Canada at the King Edward Hotel, Toronto, Canada. Topics discussed were the "Effects of Corrosion on Steel Pipe, and the Manufacture of Very Large Steel Pipes up to 96 Inches," by F. N. Speller, of the National Tube Co., and "Aeroplane Wing Tips," and "Wind Channel Intakes," both by J. H. Parkin, Jr.

At the meeting of the Boston section to be held on February 8, the following papers will be read: "Water Power Development and the Stand-by Steam Stations as Applied to the General Subject of Power Development in England" and "Recent Water Wheel Developments and Settlings," by W. M. White, chief engineer, hydraulic department, Allis-Chalmers Manufacturing Co., Milwaukee, Wis.

On February 15, at the meeting of the Buffalo section, "Modern Practice in Arc Welding" will be discussed by A. M. Candy, of the Westinghouse Electric & Manufacturing Co.

NEW ENGLAND WATER WORKS ASSOCIATION

The February meeting of this association will be held at Copley Square Hotel, Boston, February 9.

Program—11 a. m., meeting of the executive committee at the headquarters, Tremont Temple. 1 p. m., lunch will be served at Copley Square Hotel, tickets $1.50. 2 p. m., papers. "The Need of Uniformity in Plumbing Regulations," by George C. Whipple, Professor of Sanitary Engineering, Harvard Enginering School. "Relations Between Plumbers and Water Works Superintendents," by G. Wilbur Thompson, president of the Massachusetts Association of Master Plumbers. "The Hydraulics of the Flush Valve," by Gordon M. Fair, Instructor in Sanitary Engineering, Harvard Engineering School. Professor Whipple will discuss the bill which has just been introduced into the legislature by the State Department of Health. This bill contains matter of great importance to the members.

KENTUCKY HIGHWAY CONTRACTORS' ASSOCIATION

At a recent meeting of the Kentucky Contractors' Association the following officers were elected: President, George N. Eady; first vice-president, Henry Bickel; and second vice-president, George Carey.

MEMPHIS ENGINEERS' CLUB

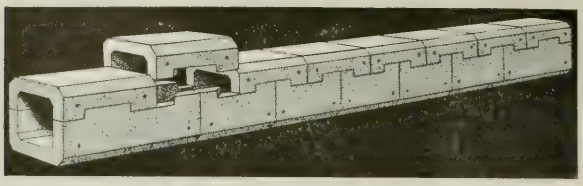
At a dinner held on January 10, the Memphis Engineers' Club elected the following officers for next year: President, Robert W. Gay; vice-president, J. H. Haylow; and secretary-treasurer, A. S. Fry.

LARGE VOTE FOR A. S. C. E. OFFICERS

An interesting feature of the meeting of the American Society of Civil Engineers held in New York on January 19 was the size of the vote for officers, 80 per cent of the corporate membership was represented in the vote, 7,008 ballots being cast. And when it is considered that about 500 members live outside of the United States or Canada and that only a small number of these voted, it can be assumed that the percentage of eligible voters in the United States and Canada who did cast votes was about 85.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



DUPLICATE UNITS OF INTERLOCKING CONCRETE CULVERT ASSEMBLED

INTERLOCKING WENDELKEN CONCRETE CULVERT

The Wendelken interlocking concrete culvert is assembled from a series of interlocking, plant-made concrete units, reinforced to withstand, without overcovering, the load imposed by a 17-ton roller, the load on any unit being distributed over a ground surface double the length of the unit.

Top and bottom units are exactly the same and interchangeable. In order to clean the culvert, the top units can be removed by means of pins or hooks inserted in holes cast in each top unit for that purpose, the culvert cleaned and the top units replaced.

The dimensions can be such as to provide the size and shape of openings necessary to meet any requirements of the relation of flow line to road surface and required discharge capacity. The smooth interior provides the minimum of frictional resistance and therefore a large discharge capacity in proportion to the area of the opening. It can be quickly installed at any time of the year and can be removed, if necessary, to another location. The design is technically correct, and the specifications conform to the recommendations of the Joint Committee on Concrete and Reinforced Concrete.

With blocks of three standard sizes having inside clear heights of 5 inches, 7 inches and 11 inches, six different sizes of culverts with clear openings of 10 x 24 inches to 22 x 24 inches can be constructed. Each unit is reinforced on all three sides by a framework of bent steel bars. The units are made in class "A" designed to carry a 17-ton roller without earth covering over the conduit and class "B" is designed to carry the same roller when the culvert is covered with 1 foot or more of earth. The width of the units are 15, 18, 24 and 30 inches and the thickness of the top and bottom the varies from 2½ to 4 inches while their capacity for discharge in second feet varies from 1.66 to 20.50, while the corresponding sizes of corrugated iron pipe capacities vary from 1.13 to 7.80.

This interlocking culvert company furnishes steel inside and outside forms for manufacture by contractors and others of the culvert units, with which it is estimated they can be made for 50 per cent of the average selling prices.

These culverts have been in successful satisfactory service in Denver for two years and the United States government has recently secured the right to manufacture them for use on thirty-five reclamation projects.

INDUSTRIAL NOTES

After February 1, the new warehouse plant of the National Cast Iron Pipe Co., at 37th street and South Ashland avenue, Chicago, Ill., is expected to be in operation. A complete line of 3-inch to 24-inch cast iron pipe and specials, as well as valve and roadway boxes, will be carried at this warehouse.

Howard H. Marsh, formerly district manager of *Railway Age*, has become president of the Victory Equipment Co., with headquarters at 444 Maison Blanche Annex, New Orleans, La., where he will handle the following accounts: McMyler Interstate Co., Cleveland locomotive cranes, pile drivers and material handling equipment; Ball Engineer Co., Erie, Pa., steam shovels and railroad ditchers; Schaefer Equipment Co., Pittsburgh, Pa., truck lever connection, brake levers, brake rod jaws and stake pockets; and Equipment Manufacturing Co., Cleveland, Ohio, trucks and trailers.

Wallace & Tiernan Co., Inc., has opened a new plant at Newark, N. J., where all its business will be conducted, including all branches of engineering, manufacturing, sales and executive work.

ADAMSON NOW MAKES TANKS, AND ARC WELDED PRODUCTS

The Adamson Manufacturing Co., East Palestine, Ohio, has added a new department for manufacturing all kinds of storage, pneumatic and pressure tanks, welded pipe, battery casings, evaporators, condensors and a large line of arc-welded products.

One of the two big plants of the Macomb Sewer Pipe Co., at Macomb, Ill., has closed down. This move was the result of a lack of orders. All of the Macomb clay industries with the exception of two plants have shut down now.

The Great Western Contracting Co., Kansas City, Mo., has changed its name to the Rawlings Industrial Equipment Co. This organization acts as sales engineers for the manufacturers of power plant machinery. Besides handling coal and ash conveyors for the Conveyors Corporation of America, Chicago, Ill., this company represents the Springfield Boiler Co. and the Cooling Tower Co.

NATIONAL STEEL FABRIC COMPANY

Announcement is made of the opening of an Atlanta, Ga., office by the National Steel Fabric Co., in charge of H. S. Gibboney, district manager, 604 Walton building.

THE AUSTIN MACHINERY COMPANY'S EXHIBIT

At the Good Roads Show and National Good Roads Congress and Convention, Chicago, Feb. 9-12, there will be included in the Austin Machinery Corporation's seventy-two-ton display in the first section of the main exhibition area, their mammoth 28E Cube-Hex paver of one cubic yard capacity (the largest all-multipedal paver in the world), road builders' crane and dragline, gasoline locomotive, industrial cars and batch boxes, trenching machine, backfiller and building mixers. Moving pictures will be run continuously.

HIGHWAY TRANSPORTATION SHOW

At the Highway Transportation Show that was held on January 3-8 by the Motor Truck Association of America in the armories at 62d street and Columbus avenue and 68th street and Broadway, New York, liberal use was made of moving pictures to show highway transportation as compared with railroads and waterways, including the film, "What's Your Hurry," featuring Wallace Reid, and the "Neck of the Bottle," which shows all forms of transportation in New York City, where there are more than 71,000 motor trucks, some of them performing extraordinary and little-known service.

Good roads films well illustrated the design and advantages of good roads, and the causes of wear, including a special slow-moving film demonstrating the effect of high speed on tires, springs, body and load of a truck traveling on a rough surface. Another film presented an animated diagram of the operation of the lubrication system and indicated the necessary repairs and maintenance.

LARGE SALES OF HIGHWAY SNOW PLOWERS

The Good Roads Machinery Co., Inc., has recently sold twenty Champion snow plows to the Marvland State Highway Department, fifty-two Champion snow plows to the New Jersey State Highway Department, sixty Champion snow plows to the Massachusetts State Highway Department and three hundred Champion snow plows to the city of New York.

The Austin Machinery Corporation has established an office at 721 Andrus building, Minneapolis, Minn., with George A. Ralph in charge.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879

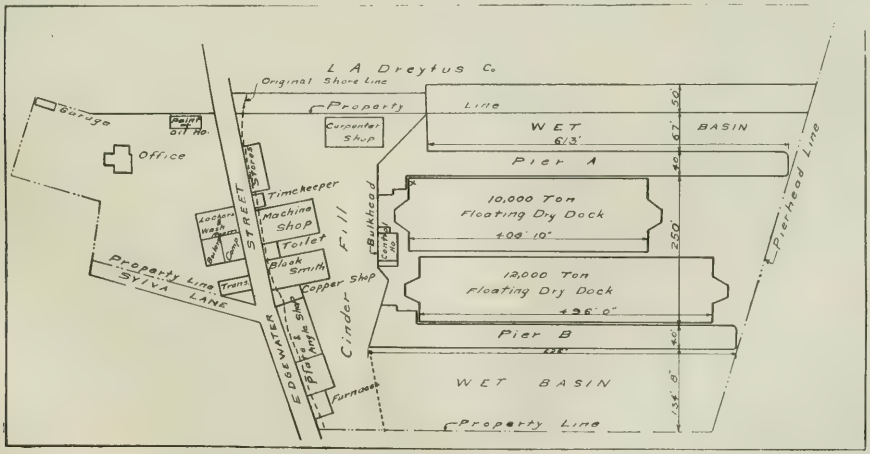
Vol. 50 FLORAL PARK, FEBRUARY 12, 1921 No. 7

New York Harbor Dry Dock Corporation's Plant

Installation on the Narrows, New York bay, includes large floating docks, piers, wet basins, yards and shops with coordinated arrangement and equipment. Structural features, construction operations and plant. Ingenious methods of difficult submerged excavation and pile driving.

The construction of twelve new large municipal piers alternating with deep water slips for ocean steamships in the Narrows of New York bay on the east side of Staten Island, now in an advanced stage of completion, together with the rapidly increasing location of great warehouses, shipbuilding plants and other important enterprises on the adjacent shore of Richmond borough, New York City, demands corresponding facilities of a semi-public nature for the maintenance and repair of the great ships that ply to this port in increasing numbers, constituting an immense factor of the public welfare and commercial importance of the metropolis, and very directly influencing the construction, maintenance and operation of all kinds of public works and utilities in the city.

One of the most recent and important of these enterprises is the establishment at Clifton, Staten Island, adjacent to the north end of the municipal pier area, of the new plant of the New York Harbor Dry Dock Corporation, which has now been practically completed and is already in operation. It was constructed entirely by Fraser, Brace & Company, engineers and contractors, New York City, who commenced operations in July, 1919, delivered the first dry dock ready for service on October 11, 1920, and have now completed nearly all of the construction work which has been rapidly prosecuted notwithstanding the universal



GENERAL PLAN OF DRY DOCKS, PIERS, YARDS AND SHOPS

difficulties encountered in the labor and material fields and in transportation, which were by no means diminished by the simultaneous and adjacent construction of more than $20,000,000 worth of very similar work for the municipal piers, which employed thousands of men and great quantities of material and equipment of exactly the same nature as were required for the dry docks enterprise.

The plant, with a waterfront of 600 feet on the pierhead line, occupies a trapezoidal area 600 feet wide and 1,000 feet long on the shore side of Edgewater street and has another irregularly shaped 300 x 400-foot area on the opposite side of the street where the offices, garage and some auxiliary buildings and storage space are located.

DRY DOCKS

The main features of the installation are the two floating dry docks of 10,000-ton and 12,000-ton capacity, which are, respectively, about 409 feet and 496 feet in length; two piers each 40 feet wide and about 600 feet and 700 feet in length; an independent 134 x 626-foot wet basin and a 67 x 640-foot extension forming part of an undivided wet basin 117 feet in width of which 50 feet lies beyond the property line separating this plant from an adjacent one. The piers extend from the corporation's new bulkhead to the pierhead line and on the shore side of the bulkhead there is a large level filled area providing space for storage, working yards, service tracks, pipe lines and conduits and for the various shops, mechanical installation, and power plant.

The floating docks are located side by side in a wet basin 250 feet wide with its level bottom dredged to a depth of 44 feet below mean low tide. They are each 117 feet wide, there is about 8 feet clearance between the docks themselves.

The docks are of similar design and are built of wood. The largest one, of 12,000 tons capacity, is 496 feet in length and the other, of 10,000 tons capacity, is 408 feet 10 inches long and 117 feet wide, with five pontoons 14 feet deep having side walls 31 feet high above the pontoon decks, 14 feet 8 inches wide at the base and 10 feet 7 inches wide at the top. They are moored to the piers by cast steel jaws bolted to the sides of the piers and engaging the flanges of steel channels mounted on the sides of the dry docks. This prevents the docks from moving horizontally, while leaving them free to move vertically through the full range required in using them.

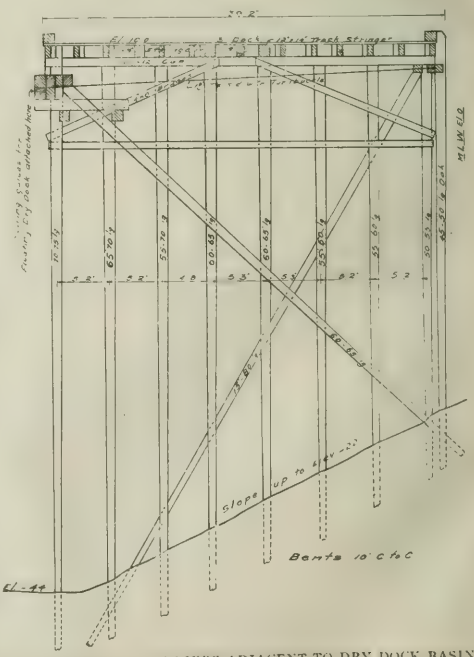
PIERS AND BULKHEADS

The piers have timber decks 10 feet above mean low water, supported on transverse pile bents 10 feet apart, each bent containing nine vertical piles and two inclined brace piles reaching across the full width of the bent and framed to the ends of the cap timbers. Diagonal transverse struts above low water form in connection with the spur piles, a system of transverse X-bracing for every bent. The piles were driven in water from 22 to 44 feet deep at mean low tide and to an average penetration of about 18 feet.

There is about 600 linear feet of bulkhead on a crooked alignment made up of tangents from 25 to 250 feet long. It was built outside the original shore line and has a timber deck supported at an elevation about 2½ feet above low tide on transverse pile bents 5 feet apart longitudinally. The floor carries, along the bay side, a concrete bulkhead wall about 7½ feet high 6 feet thick at the base and 2½ feet thick at the top, which retains 7½ feet of cinder fill covering the remainder of the deck and extending with decreasing depth over most of the yard area beyond the original shore line. On the land side of the bulkhead the fill down to the original bottom of the bay below low tide elevation is retained by a line of 8-inch wooden sheet piling. Each of the foundation pile bents has seven vertical piles from 35 to 50 feet long and four spur piles driven at angles of approximately 30 degrees with the vertical, and framed at their upper ends to longitudinal ranger timbers moulded to the pile caps. The bulkhead piles were driven in water varying from 5 to 22 feet in depth.

PILE DRIVING

There were driven for the piers and bulkheads 3,900 piles of an average length of 53 feet, and to an average penetration of 18 feet. The best day's record was 30 piles driven by one crew. Most of the piles were driven after the dredging had been partially completed between the piers but before the bottoms of the slips had been en-



TYPICAL SECTION OF PIERS ADJACENT TO DRY DOCK BASIN

tirely leveled and trimmed thus permitting the work to be expedited by commencing the piers before the last 4 or 5 feet of dredging had been completed.

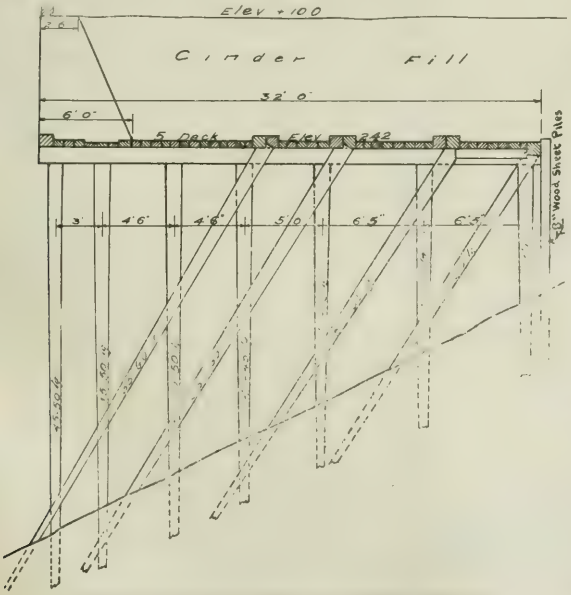
All of the vertical piles were driven by two floating machines, one equipped with a 40 h. p. Mundy boiler and engine and a 3,200-pound drop hammer, and the other equipped with a 30 h. p. boiler and engine and 3,000-pound hammer.

(To Be Continued)

Effect of Cleaning Boilers

A 100-horsepower return tubular boiler used for operating the municipal pumping plant of Chisholm, Minn., was found to be in bad condition by C. J. Sullivan, superintendent of the works, when he took charge of the plant some time ago, the boiler not having been cleaned since it was installed. The reason given for this neglect was that there was only one boiler and the filtered water supply which could be stored was not sufficient to warrant a shut-down long enough to permit cleaning the boiler.

Mr. Sullivan obtained permission from the electric light company to connect the village boiler to one of the boilers of that company's plant which was about 200 feet away. A 4-inch pipe line was run between the header of the water works boiler and that of the electric light company and the steam of the latter used for three days, while the municipal boiler was out of service. Before doing this, a 24-hour test run was made which showed 3 tons of coal consumed during this period. After cleaning the boiler and making some changes to the open heater, two similar tests showed a coal consumption of slightly less than one ton for the 24-hour period. Based on the price of coal at that time, this effected a saving of over $4,000 a year.



SECTION THROUGH BULKHEAD PLATFORM AND WALL

Break in Lancaster's Water Main

By John T. Brainard*

Six million gallons of water lost by bursting of thirty-inch main. Hydraulic valves closed by emergency air compressor.

On January 11, at 7:45 p. m., the recording gauge in the office of the Lancaster, Pa., water works dropped suddenly from 100 pounds pressure to 30 pounds. The entire plant is electrified and the pumps were immediately shut down and the engineer notified the superintendent, C. K. Will, and the chief engineer, John C. Coyle. Mr. Will at once had his men close the valves leading from the reservoir and standpipe. Before these could be closed, however, the reservoir had been drained down to 3 feet of water and the 400,000-gallon standpipe, which is 112 feet high and maintains pressure in the high-pressure system, was completely emptied. It was estimated that more than six million gallons of water escaped.

Two mains lead from the main pumping plant, one a high pressure, 30-inch main and the other a low pressure, 36-inch main. Ordinarily the 30-inch main is used to fill both the reservoir and the standpipe. It was found that this 30-inch main had broken, washing out the road in which it was laid and carrying a considerable amount of road material into a neighboring quarry. The superintendent and chief engineer happened to come along the road just at the time when a sudden gush of water washed out the road-bed from under their automobile, causing one side of the machine to drop into the trench and injuring Mr. Will.

A repair gang was put to work early the following morning. They found that the pipe, which had been laid about 20 years ago, had broken, apparently at a flaw, a section of the pipe 7½ feet long having been blown out. A section 8

*SECRETARY, Dept. of Water, Lancaster, Pa.

BREAK IN 30 INCH WATER MAIN

AUTO DITCHED IN WASHED-OUT TRENCH

feet long was cut out of the main, which is 1½ inches thick at this point, and by 9:30 in the evening of the same day a new piece had been inserted and water was turned on.

As soon as the leak had been located and the valves into this main been closed, pumping was resumed through the 36-inch main at the main pumping plant and a 10-million-gallon electric booster pump at the reservoir was put into service pumping water from the reservoir to the standpipe to give water to the high-service consumers. The booster pump was put into service at 3:30 a. m. A Bristol recording gauge is located in the office of the water department at the city hall. The usual pressure during the day is 54 to 60 pounds and somewhat lower at night. Owing to the service given by the unbroken 36-inch main, this pressure did not fall below 25 pounds, and by 4:10 in the morning after the break had risen to 55 pounds.

The valves at the pumping plant are all hydraulic, working under a water pressure of 75 pounds. As the pressure at the plant had fallen below 30 pounds they could not be operated hydraulically, but were closed by using an electric air compressor which had been installed for this purpose. This is the first time the air compressor has been used for operating the valves since the plant was electrified and it worked very satisfactorily.

Bids on New York Highways

Bids were asked on 20 roads in 16 counties of New York State by the State Highway Commission, to be received up to January 26, and on that date 83 bids had been received, or an average of about four to each contract. At the request of Governor Miller, Highway Commissioner Greene did not award the contract in view of the fact that the new commissioner, Herbert S. Sisson, would assume the duties of office six days later.

Installation for a $700,000 Concrete Road Contract

Materials distributed over 10 miles of road from central storage in batch boxes hauled by locomotives on full-length 24-inch service track. Abundant equipment provided for distribution and construction operations.

Contracts 27-28 and C. N. 3 for the construction of about 10 miles of standard concrete highway were awarded by the Delaware State Highway Department in March, 1920, to the Keystone State Construction Co., Philadelphia, for the estimated price of about $700,000. The work consisted of three roads radiating at approximately equal angles from Pine street corner 5.6 miles to Armstrong's corner, 2½ miles to Odessa, and 1¾ miles to Townsend. The entire job involved about 40,000 barrels of cement, 50,000 yards of broken trap rock imported from Pennsylvania and 25,000 yards of sand purchased from dealers and all delivered by rail to the storage yards at Townsend, where the contractor has established headquarters on a 150 x 1,500-foot yard adjacent to the Philadelphia, Baltimore & Wilmington Railroad tracks.

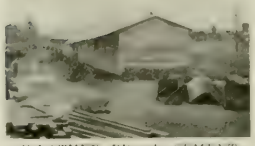
Along one edge of the lot there is a railroad siding 900 feet long that passes close to the 20 x 150-foot storage house of 4,000 barrels capacity, and has a switch connecting it with an adjacent dumping trestle 350 feet long and 8 feet high with a 2 per cent grade, from which all the sand and gravel is dumped in long piles from which it is reclaimed by a Browning steam locomotive crane running on a standard gauge track parallel to the siding and 25 feet distant from it. Another parallel track 50 feet from the siding with 24-inch gauge and 800 feet long runs through a timber-lined tunnel 8 feet wide, 7 feet high and 200 feet long, over which the sand and broken stone are piled by the locomotive crane. The service track extends beyond the ends of the tunnel, and at one end makes a loop passing tangent to the cement storage house and connecting with the main line that runs the full length of the three different sections of road included in the contract.

UNLOADING BULK CEMENT

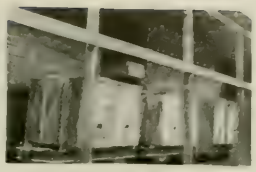
Portland cement is received in bulk in carload quantities and is unloaded by hand, a process which was found by investigation to be quicker and more desirable than the use of any of several mechanical processes investigated, including the vacuum process, the installation of which would have involved a cost of $8,000.

'Acknowledgment is made to the Atlas Portland Cement Co. through whose courtesy the accompanying illustrations are reprinted from "Contractor's Atlas."

LOADING TUNNEL BEFORE SAND AND GRAVEL WERE STORED OVER IT



WEATHER PROOF CEMENT SHED



DELIVERING CEMENT TO BATCH BOXES

The cement storage house is very substantially built to exclude moisture and dampness. It has a concrete foundation and a concrete floor at ground level. The doors on the railroad side are so located that the cement can be discharged from the car directly into the house when shoveled by two men into the flared upper end of a wooden chute with cloth nailed over the top to confine the dust. When it becomes inconvenient to shovel into the chute it is removed and the remainder of the cement is unloaded by wheelbarrows.

MEASURING AND DELIVERING CEMENT

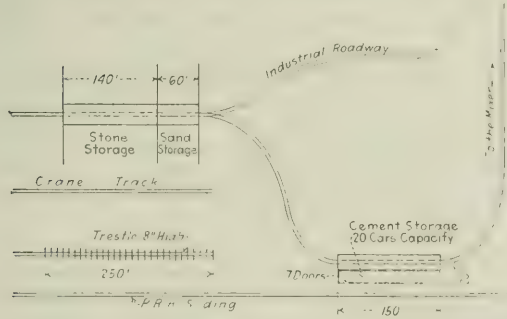
The doors of the cement house are spaced to match the batch boxes on a train of industrial cars. The door sills are 7 feet above track level and on each sill there are two tilting boxes, each holding 4 cubic feet of cement for one batch of concrete.

These boxes are easily filled by hand pails ready for the train of industrial cars. When it is spotted in position the boxes are tilted and discharge the cement through their automatic lift gates to the batch boxes.

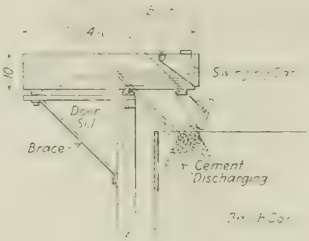
MEASURING AND DELIVERING CONCRETE MATERIALS

There are provided 68 steel batch boxes and about half as many steel Koppel cars hauled in trains of 10 each by 3 Plymouth gasoline locomotives that are kept constantly busy running back and forth between the mixer and storage.

Each locomotive hauls alongside the cement house a train with two empty batch boxes on each car, where each box is filled with cement up to the gauge mark. The train is then hauled by a mule or pushed by hand and the cars spotted under twenty of the forty steel Lakewood gates in the roof of the tunnel, which are opened to fill the batch boxes up to the next gauge mark with sand, after which they are moved forward underneath the stone gates and the remaining space in each box is filled with stone. The loaded train is then hauled to the 5-bag mixer. The mixer was started at one end of the contract and moved rapidly forward at a rate which it is hoped will eventually provide for the completion of 20,000 linear feet of road per month when all operations are in full swing and the total maximum force of about 350 men have become well trained and expert in their respective duties.



PLAN OF CENTRAL LOADING, UNLOADING AND STORAGE PLANT



TILTING CEMENT MEASURING BOX

CONCRETING AND FINISHING

The concrete is placed between steel forms of the Blaw and of the Heltzel types, 1,000 linear feet of each of which have been installed for comparison. Sub-grade is rolled by a 10-ton Austin gasoline machine and by a 10-ton Buffalo steam roller and by two smaller rollers. The pavement is finished with a Lakewood finishing machine.

AGGREGATE STORAGE PILES AND LOADING TUNNEL

TRAIN OF BATCH BOXES ON SERVICE TRACK AT MIXER

DELIVERING BATCH BOX FROM TRAIN TO MIXER

After a section has been completed it is protected by movable muslin screens, enough of which are provided for 1,000 linear feet of roadway.

The road is drained by long ditches with light grades, and the principal structures consist of five reinforced concrete arch bridges of 10 to 50 feet span with pile foundations, and one 10-foot and one 6-foot concrete culverts about 60 feet long. For their construction there is provided a Lakewood hoisting tower and chute with a small concrete mixer.

QUANTITIES AND EQUIPMENT

The execution of the three contracts involved about 150,000 yards of excavation, mostly steam shovel work, with cuts of a maximum depth of 15 feet. All of the excavated material is used for grading, besides which about 40,000 yards of sand are excavated for the same purpose from two borrow pits and hauled for a maximum distance of 1 mile in side-dump steel cars operated by the gasoline locomotives on a 24-inch service track.

Each of the borrow pits is drained by a gasoline pump delivering to an elevated wooden supply tank, from which the water is piped to all parts of the work through a 2-inch line. Another gasoline pump connected to driven wells also delivers to the tank, but the main supply is from a 9 x 6¾ x 10-inch Worthington steam pump that forces the water 1 mile from a 15,000-gallon reservoir that the contractor made by the construction of a small earth dam 65 feet below the top of the storage reservoir.

The gravity system furnishes sufficient water for all parts of the work and is equipped with release and expansion valves that provide for its operation with the minimum of maintenance or attention.

At headquarters there are a smith shop, repair shop, machine shop, storage houses, offices and a stable 135 feet long for 36 horses and mules. The principal items of equipment include one No. 21 Marion steam shovel, one No. 31 Osgood steam shovel, one 120 h. p. Holt caterpillar tractor for hauling trees and stumps and transporting material in trailers, sometimes seven or more at once. There are a Jumbo grader, three motor trucks, two automobiles, three gasoline locomotives, 61 ¼-yard Koppel ideal-type side-dump steel cars, a considerable number of horse-drawn scrapers, plows, wagons and other tools, besides the special machinery previously mentioned.

Service Strength of Sewer Pipes

Relative effects that different methods and conditions of laying pipe have upon the strength of the sewer, as laid, to support exterior loads. Conclusions from tests made by the engineering experiment station of Iowa State College. Effect of sand bed and concrete cradle.

The subject of the strength of sewer pipe to resist pressure exerted upon it from above when laid in trenches and the amount of such pressure has been the subject of investigation for several years by the engineering experiment station of the Iowa State College. The conclusions from studies and tests made at this station were described at some length in "Municipal Journal" for October 15, 1914, and February 23, 1918. The latter article contained a series of tables giving the ordinary maximum loads on pipes in ditches from common back-filling materials for different widths and depths of trench and different kinds of material; also the ordinary supporting strength of sewer pipe, as determined by the standard test, in pounds per linear foot required for such conditions.

Recently the experiment station has published a further bulletin on the subject, entitled "Supporting Strength of Drain Tile and Sewer Pipe under Different Pipe-Laying Conditions," in which is set forth the relative effect of pipe-laying condition upon the strength of the pipe, as laid, to support exterior loads.

The conclusions refer to pipe laid by the "ordinary" method as a basis of comparison. The ordinary method is "that in which the under side of the pipe is carefully bedded on soil for 60 to 90 degrees of the circumference, suitably rounding the bottom of the ditch for this purpose and digging hub holes for all pipe with hubs, and in which the pipe is surrounded with soil placed with ordinary care." Methods least effective in bringing out the strength of the pipe were termed impermissible methods, the bottom of the ditch not being suitably rounded to fit the under side of the pipe or hub holes not being properly dug, or re-filling material not being placed so as to fill all around the pipe, or other defects of a similar general character being permitted. Where these departures from the ordinary method occur the strength of the pipe was found to be only about 80 per cent of the ordinary strength. By employing "first-class" methods or using concrete cradles, the supporting strength may be increased. By "first-class" method is meant one "in which the under side of the pipe is very thoroughly imbedded in soil for at least 90 degrees of the circumference (suitably rounding the bottom of the ditch for this purpose and digging hub holes for pipe with hubs) and the entire pipe is surrounded with thoroughly compacted soil, all under the direction of a competent inspector constantly on the work."

In discussing the matter of the strength of a pipe after it has cracked, the author, W. J. Schlick,

points out that, with the pipe cracked into four quadrants (with cracks at top, bottom and each springing line), as is ordinarily the case, resistance to collapse of the sewer depends almost entirely upon the ability of the earth at the side cracks to withstand the horizontal thrust exerted by the two top quadrants. The aid which the earth furnishes to prevent the cracking of the pipe is indicated by the fact that measurements made on vitrified pipe 18 to 30 inches in diameter show that the lengths of horizontal diameters increased only from 0.027 inch to 0.0632 inch before the pipe cracked. "It is difficult to imagine a soil so firm that it would not be compressed the amount of this distortion on each side (from 0.0135 to 0.0316 inch) by a comparatively low pressure." However, where the pressure is distributed over a considerable area by concrete between the pipe and the side of the trench, considerable resistance to collapse of a cracked pipe may be furnished.

The report contains detailed descriptions of the manner of making the tests and the results, with photographs showing the manner of laying pipe, etc., the whole occupying 68 pages. The conclusions are summed up by the author in the following general statement:

Factors Aside from the Quality of the Pipe Affecting the Supporting Strength of Pipe in Ditches

"A. The supporting strength of the pipe in the ditch depends quite largely upon the area of the foundation to which the load on the pipe is transmitted and the uniformity of the distribution of the pressure over this area. A high supporting strength requires a wide and uniform distribution of the pressure between the pipe and the soil upon which it rests.

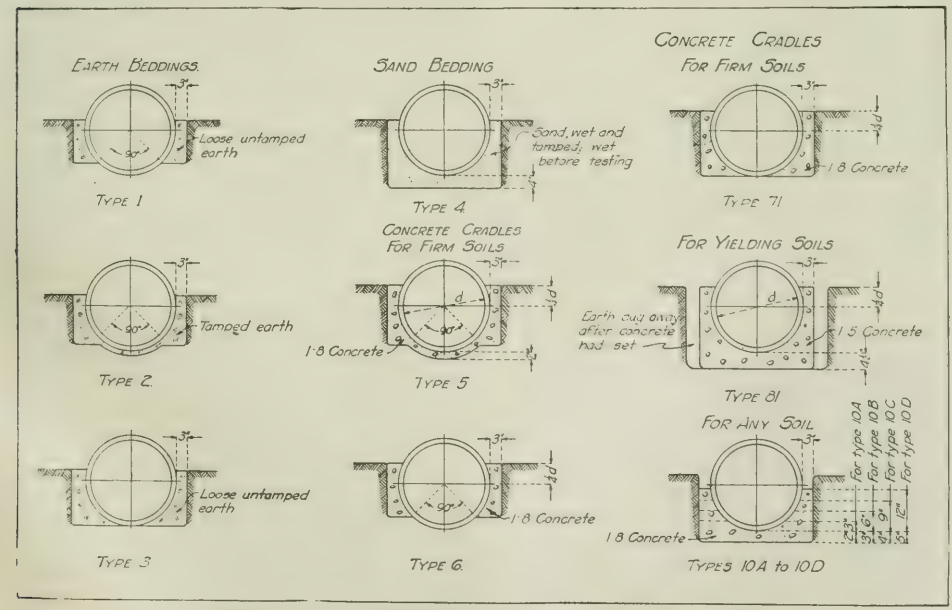
"B. The range in the supporting strengths of similar pipe in one of the general types of bedding, or methods of pipe laying, is small, comparatively. Variations in supporting strength will always exist because of variations in the pipe themselves, in the soil and in the methods of laying, so that it is impossible, at this time at least, to formulate rules that will obviate the necessity for the engineer to use his judgment in determining the probably average supporting strength which the pipe for a particular job will develop. Because of these facts it is both practicable and desirable, to group pipe-laying methods into classes or general types, as has been done in this investigation. The percentage of increase in supporting strength (before cracking) due to the use of concrete-cradle pipe-laying methods will depend upon the quality of the pipe themselves, the form and dimensions of the cradle and the quality of the concrete used in forming it.

"From the data at hand it seems rational.

1. To group pipe-laying methods in earth into three classes "ordinary," "first class," and "impermissible."

2. To class pipe-laying methods in sand and gravel, similar to those included in these investigations, as "first class," but to restrict their use to cases where hub-and-spigot sewer pipe are being used and the joints filled or calked.

3. To group concrete-cradle pipe-laying methods into four classes: "Combined earth and concrete-cradle," "concrete-cradle methods for any



DIAGRAMS SHOWING METHODS OF PIPE LAYING INVESTIGATED IN 1916.

soil," "concrete-cradle methods for firm soils," and "concrete-cradle methods for yielding soils."

"In considering this grouping in connection with the data given herein, and in applying these data to his problems the engineer must not lose sight of the fact that some types of concrete cradles may be used in either firm or yielding soils, that some types of cradles are particularly adapted to use in a particular kind of soil and that the increase in supporting strength due to the use of a particular type of concrete cradle will depend, to some extent, upon the character of the soil in which it is to be used.

"C. The side support (resistance to horizontal thrust) obtainable in most soils is of little value in increasing the supporting strength (before cracking) of the pipe. When pipe are incased in concrete the pipe and the concrete act as a unit in resisting the deformation due to the load upon the pipe, thus increasing the supporting strength of the pipe.

"D. The supporting strength of a cracked pipe depends upon the bearing power of the soil at the sides, irrespective of the method of pipe laying, and upon the length of the time of continuous application of the maximum load. The presence of concrete at the sides of the pipe provides for a wider distribution of the side pressure, which, in some soils, results in a high supporting strength for a cracked pipe.

"E. The 'ordinary supporting strength' (i. e., the supporting strength of drain tile and sewer pipe with the 'ordinary' pipe-laying method or in the laboratory test with sand bearings) is the rational basis from which to calculate the supporting strength of the same or similar pipe under any other pipe-laying condition.

"F. The safe supporting strength (using a factor of safety) of drain tile or sewer pipe is the supporting strength before cracking. The supporting strength after cracking depends upon the bearing power of the soil, which may change due to any of several conditions, each of which is probable in different cases.

"G. A factor of safety of 1½ is both necessary and sufficient to prevent cracking. This means that to insure safety against cracking the average supporting strength of the pipe to be used, with the method of pipe laying chosen, should be 1½ times the probably maximum load upon the pipe.

Regarding Particular Pipe-Laying Methods

"H. The supporting strength developed by drain tile and sewer pipe with the 'ordinary' method of pipe laying is equal, with close approximation, to the average 'ordinary suporting strength' of the same or truly similar pipe, as determined by the standard test using sand bearings.

"I. The 'first class' method of pipe-laying increases the supporting strength of the pipe from 20 to 25 per cent.

"J. The supporting strength developed by pipe with the 'impermissible' pipe laying methods is only about 80 per cent of the 'ordinary supporting strength' of the same or truly similar pipe.

"K. The supporting strength developed by pipe bedded upon and surrounded by sand is approximately equal to that developed by the same or truly similar pipe with 'first class' pipe laying. Drain tile should never be placed in beddings of this kind.

"L. The supporting strength of drain tile and sewer pipe can be increased from 50 to 100 per cent by the use of properly designed concrete cradles, the amount of the increase in a particular case depending upon the character of the soil, the dimensions and shape of the concrete cradle, the quality of the concrete and the comparitive strength of the pipe used."

Protecting Metal Flumes

The Department of Public Works of Nebraska has oversight over the irrigation systems of the state, which include several metal flumes. These flumes are more or less affected by rust and one of them was found in the spring of 1918 to be in a very bad condition, the rust having penetrated the steel so that the bottom of the flume was full of small holes varying in size from a pin-hole to about ⅛ inch diameter. As an attempt at a temporary remedy, one coat of coal tar was applied to the inside of the flume. This seemed to seal up all the holes, and no further trouble from leakage had been noticed since then. (The report was dated November, 1920.) Previously experience had been had in painting flumes with water gas and coal tar in 1916 and 1917 and these also seemed to be about as good last November as when first put on three or four years earlier. "Prior to that time the experience had with a variety of paints tried on metal flumes was that the paint would peal off during its first water season. It therefore appears that water gas and coal tar is a very good paint for metal flumes and it is also a cheap paint."

Street Work in Chicago

Chicago ordinarily builds more than 160 miles of alley and street pavment a year, but last year built only 55.1 miles because of the high cost of material. It is expected to build about 150 miles of streets and alleys in 1921 which may cost $8,000,000 or more, although the cost is considered indefinite under present market conditions.

Indiana Concrete Road Specifications

The Indiana State Highway Department has changed somewhat its specifications for concrete roads this year. The old specifications require 1.91 barrels of cement per cubic yard, while the new ones require only 1.7 barrels. The chief engineer of the department, C. Gray, is quoted as saying that the mixture under the old specifications was so rich as to cause an unnecessary amount of cracking and that the decision to decrease the amount followed a conference with James T. Voshell, district engineer for the Federal Bureau of Public Roads. He said that more or less cracking has appeared in the 45 miles of concrete road completed under the old specifications.

PUBLIC WORKS

Published Weekly
by
Municipal Journal and Engineer, Inc.
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba....$3.00 per year
All other countries .....$4.00 per year

Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

CONTENTS

NEW YORK HARBOR DRY DOCK CORPORATION'S PLANT Illustrated 141
Effect of Cleaning Boilers 143
BREAK IN LANCASTER'S WATER MAIN—Illustrated—By John T. Brainard 143
Bids on New York Highways 144
INSTALLATION FOR A $700,000 CONCRETE ROAD CONTRACT—Illustrated 144
SERVICE STRENGTH OF SEWER PIPES—Illustrated 146
Protecting Metal Flumes 148
Street Work in Chicago 148
Indiana Concrete Road Specifications 148
EDITORIAL NOTES 149
Strength of Sewers—Municipal Bonds—A Notable Engineering Distinction
Coarse Sand in Road Construction 150
Dr. Waddell Receives Norman Medal for Third Time 150
Joseph C. Rock 150
F. S. Wardwell 150
HOW CAN A BUILDERS' AND CONTRACTORS' GET-TOGETHER CLUB BE ORGANIZED AND FINANCED? 151
Immigration Notes 153
National Federation of Construction Industries Opposes Johnson Immigration Bill 153
Exaggerated Estimates of Unemployment 153
500 Indictments Expected 153
RECENT LEGAL DECISIONS 154
PAVEMENTS LAID DURING 1920 155

Strength of Sewers

It is not often that a modern sewer collapses, although occasionally an old stone one does so, or the invert may wear out in a storm sewer, or it may be blown up by gasoline or other accident happen to it. But failure from outside pressure is rare, except where it is near the surface and a heavy truck or other load is placed on the surface over it.

If it were perfectly cylindrical and buried in a fluid it would be almost impossible to crush it; and as the conditions approximate this does the danger of collapse lessen. A circular sewer in dry sand or in muck is probably the nearest approximation to it. Whatever the soil, once it has settled into place entirely around the sewer, very little pressure is exerted upon the latter. (This does not include broken rock placed directly on the sewer, which never should be done.) In fact, when this condition of soil stability around the sewer has been reached in the case of clayey or loamy soils, the sewer itself could be removed if a small one and the soil might not at once collapse; immediate collapse being generally less probable the less the soil approximates a fluid condition. In any case, when soil stability has been reached a sewer could be pretty badly cracked without collapsing.

The critical period of a sewer is its first few months, while the soil is settling and the cement (if it is a concrete or brick sewer) has not reached its maximum strength. These once passed, collapse is likely to occur only through a movement of the soil that destroys its stability, as by an excavation nearby, a broken water main, growing tree roots, etc.; or by the action of an acid or alkali in the sewage, or some other agent of chemical action which destroys all strength of the sewer wall.

But a sewer must possess some strength and when first laid this may need to be considerable. Just what, is one of the most difficult of determinations because of the difficulty of learning the pressures exerted by unstable soil and the local variations in such pressures. Determining the strength of a pipe or sewer to resist any assumed kind and degree of pressure is comparatively simple.

Probably the most elaborate series of experiments ever conducted in an effort to learn the principles and factors involved has been conducted by Iowa State College. Results of the first series were given in "Municipal Journal" for February 23, 1918; further conclusions are given in an article in this issue. These refer only to circular pipes, but many of the principles apply to brick and concrete sewers also. Brick sewers have little beam strength, however, but act largely as a voussoir arch; while a reinforced concrete sewer acts more like a sewer pipe, with considerable internal strength to resist distortion.

One fact brought out is that external pressure likely to cause distortion or cracking may, when soil conditions are unfavorable, be reduced a third by surrounding the sewer with sand or other material that runs freely—a suggestion that may sometimes be practicable and worth while.

Municipal Bonds

Although nearly seventy million dollars of municipal bonds were sold in January, the demand caused an upward tendency of prices. Chicago floated more than eleven million at 4 per cent; Oregon half a million at 4½ per cent; Cincinnati, Detroit, Rochester and Philadelphia more than ten million at 5 per cent.

The total amount, as compiled by the "Daily Bond Buyer" was $66,474,961. This is less by twenty million than the sales of January, 1920, but larger than any other January except 1914. The rate is still rather high compared with prewar conditions, but not sufficiently so to prevent the issuing of bonds (for short terms—5 or 10 years—if thought desirable, to be refunded later at better rates) for carrying out any needed public works.

A Notable Engineering Distinction

The American Society of Civil Engineers has awarded the Norman Medal for 1920 to Dr. J. A. L. Waddell for his paper on the "Economics of Steel Arch Bridges" which, in competition with all of the other important papers presented to the society during the year 1920, was judged worthy of special commendation for its merit as a contribution to engineering science.

This medal is one of the most important recognitions conferred on civil engineering research by the great national society that stands for the highest technical ability in this country. The fact that it has now been awarded for the third time to Dr. Waddell is without precedent in the history of the medal and is a worthy recognition of Dr. Waddell's indefatigable research, analysis and able presentation of various important engineering topics on which he has written.

There have been fifty awards of the medal; forty-five engineers have received one medal, four engineers have received two medals, but Dr. Waddell it the first to receive three medals.

Coarse Sand in Road Construction

In Indiana, aggregate producers were having difficulty in getting material to meet the specifications of the state highway commission of that state for gravel aggregate for concrete roads. The specifications called for coarse aggregate from ¼ inch up, permitting a tolerance of only 5 per cent material passing the ¼-inch screen. The Indiana gravel banks have an excess of coarse sand. To relieve this situation a long series of tests was undertaken by Purdue University under the direction of Professor W. K. Hatt, and while the results of the tests are not as yet completely known, it is indicated that in concrete of the richness used in roads, comparatively high percentage of this coarse sand may be used without decreasing the strength of the concrete. As a consequence the new specifications may allow a tolerance of 15 per cent of material passing the ¼-inch screen in the coarse aggregate.

Dr. J. A. L. Waddell Receives Norman Medal for Third Time

The American Society of Civil Engineers has awarded the Norman Medal for 1920 to Dr. Waddell for his paper entitled "The Economics of Steel Arch Bridges." The previous awards to Dr. Waddell were in 1909 on his paper "Nickel Steel for Bridges," and in 1916 on his paper "The Possibilities in Bridge Construction by the Use of High Alloy Steels."

The Norman Medal was instituted and endowed in 1872 by the late George H. Norman, member of the American Society of Civil Engineers. The code of rules governing the award require that: "All original papers presented to the society by members of any class, and published in the Transactions during the year for which the medal is awarded, shall be open to the award, provided that such papers shall not have been previously contributed in whole or in part to any other association, nor have appeared in print prior to their publication by the society, nor have been published in the Transactions in any previous year.

"The medal shall be awarded to a paper which shall be judged worthy of special commendation for its merit as a contribution to engineering science."

Joseph C. Rock

Joseph C. Rock died at his residence, 1340 Madison avenue, January 26, at the age of 75, after a lingering illness of seven months.

Mr. Rock was general agent of the United States Asphalt Refining Co. and was for many years an official of the Barber Asphalt Co. He was one of the pioneers of the asphalt paving business and introduced this class of pavement throughout many cities in the United States twenty-five years and thirty years ago and on this account he was well known throughout the country. He also was president of a company which did a large amount of asphalt paving for the borough of Manhattan.

At the outbreak of the Civil War, although only 15 years of age, Mr. Rock joined a Vermont regiment and served throughout the Civil War.

Subsequently he was connected with several government departments in Washington and while with the Bureau of Engineering in the District of Columbia he removed to New York in 1889 to accept the post of secretary with the Barber Asphalt Paving Co.

He is survived by a granddaughter, Miss Elizabeth R. Brackett, and several brothers and sisters.

The interment was at Washington, D. C., Saturday, January 29.

F. S. Wardwell

Frederick Schuyler Wardwell, an eminent civil engineer and contractor and a prominent citizen of Stamford, Conn., died in that city after a short illness January 15. He built trolley and street car lines in the east and in the west and later electrified some of them. For the past twenty years he was principally engaged in harbor improvements, water-front construction, dredging and general contracting. He was very successful in laying large submerged water mains, some of which he installed under difficult conditions and at a great depth. He did a considerable dock work and was especially successful in various kinds of submerged construction. He purchased, built, equipped and improved a large plant, including a number of dredges, derrick boats and other floating equipment for harbor work.

He was prominent in local, civil and civic affairs and was a member of the American Society of Civil Engineers, Connecticut Society of Civil Engineers, past president of the Stamford Engineering Club and was associated with public improvements and business interests.

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems different will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

How Can a Builders' and Contractors' Get-Together Club Be Organized and Financed?

The character and purposes should be suggested to a circle of friends and associates, a meeting called, temporary chairman appointed, preliminary officers selected, prearranged constitution be submitted to committee, amended and adopted and signed by those present. Legal incorporation is optional and may be delayed. The small necessary expenses may be met by preliminary contributions and by very moderate initiation fees and dues.

Ohio, January 14, 1921.

Editor, PUBLIC WORKS.

Dear Sir: We are endeavoring to organize a builders' association here. I have been appointed on a committee to find out what would be the best rules and regulations and also by-laws for such an organization.

We wish to take in Carpenter, Brick, Stone, Painting, Plastering, Electrical, Roofing, Tinning, Concrete, Excavating, in fact, any kind of contractor or superintendent over either the entire job or any portion of the work.

We do not wish to set this organization up as a price-fixing body, but as a get-together club for mutual benefit.

We do not wish to be exclusive, but would like to have some suggestions who should be asked as members and who kept out.

We would like some information as to how to finance such an organization.

We would like to know if an organization of this nature would be legal and if properly managed might prove of benefit to the members.

If we are not asking too much of you in this matter, could you refer us to some authority on the subject. Thanking you, I remain,

Very truly yours,
CONTRACTOR AND BUILDER.

A get-together association of men interested in building operations should be easily organized and maintained in any town large enough to have a number of individuals or firms engaged in each of the principal trades. Meetings at regular intervals should very much promote good fellowship, the adjustment of misunderstandings or differences, the exchange of experience and helpful suggestions for difficulties.

If properly started on the right lines and promoted by a few vigorous, persistent members it should be a success from the first and steadily grow, soon becoming an important local institution with recognized social and business influence.

INCORPORATION OPTIONAL

There are no legal difficulties to the creation and maintenance of such an institution, and no formalities are indispensable if it is to be purely of a social and informal nature. If, however, provision is made for permanent development, the association will naturally wish to hold some property and be responsible and have recognized legal standing, in which event it should be incorporated under the laws of the State.

Incorporation can be accomplished at any future time with very little trouble or expense. Copies of the incorporation laws and application blanks can be had by request of the Secretary of your State and can be filled out by one of your members or the entire work can be done at small expense by any satisfactory local lawyer.

PRELIMINARY ACTIVITIES

To begin with, a circular letter might be simultaneously mailed to the different individuals that you would like to have associated in this organization. The letter should fix the day and hour at which a meeting is called at a private residence, any public room that is available, or the rooms of any existing club or organization which would probably be cheerfully offered for the purpose.

The letter should state very briefly the purpose of the meeting, namely to consider the organization of a local club or social and informal business meetings connected with the different branches of construction, for the purpose of keeping up to the times and affording mutual benefit and promoting good understanding among members and improved methods, operations and general business prestige.

Previous to the meeting, conferences should be held with some of the representative men invited and they should be requested to be prepared at the meeting to state how such an organization could help their business and what they would like to have it do and what they would like to have it avoid. They will willingly contribute a few dollars for preliminary expenses, if these are necessary, and should ultimately be reimbursed when the club collects fees and dues.

THE FIRST MEETING

A few of the best men, and those who are known to be harmonious with each other and with the promoter of the organization, should be consulted in advance and one of them should be prepared to nominate from the floor a temporary chairman. When nominated, he should request some one present (or some member may well have his steno-

rapher there for that purpose) to act as secretary pro tem. This having been done, some other person will be prepared to move that the officers be duly elected for the evening, and after this has been accomplished another member, also previously prepared, should propose the names of three or four men to serve as a committee on constitution.

One of these members should be previously provided with a simple and comprehensive outline of a constitution, as brief as possible and covering only essential points. When this is approved or modified by the committee and put before the meeting it will probably be adopted and then, as soon as those present have signed it and paid their initiation fee, they will become charter members, after which subsequent membership will be by regular process of application, consideration and voting. The election of officers should follow immediately and the appointment of standing committees, and the organization will be in full working order.

FUTURE DEVELOPMENT

This procedure involves no legal obligation and need not follow closely the suggestions above named, which may be modified, omitted or extended at pleasure and are only given to serve as a sort of basis from which you can easily make any changes or development suited to your preferences or local conditions. Under such an arrangement the club can function either for social or business purposes or both, and can expand or change as much and as long as you please and can at any time be incorporated without material change, in the manner at first mentioned.

A certain amount of formality, without irksome restrictions or requirements, is desirable to give the club greater dignity and impress its value on the members and in order to have regular operations.

Whenever the size and prosperity of the club makes its permanent home necessary, it will be easy to finance it by moderate subscriptions and by issuing small denomination bonds which will be purchased by members and their friends.

MODELED ON SIMILAR ORGANIZATIONS

A good way to plan the constitution and general features of the club would be to borrow a copy of the constitutions of all the social or business organizations at hand and compare them, selecting here and there any feature that it is desirable to adopt, modify or reject. These will give sufficient hint for anyone interested in the matter to compile a trial constitution that can be discussed and modified and perfected by the committee and can at any time after its adoption be amended by the club itself.

There are associations of builders and contractors in most large cities and towns, and if these are not known to you many responses would probably be obtained by simply writing a circular letter addressed to the builders' or contractors' club of any city or large town you may select. Among the important organizations of this kind there are following, The Master Builders' Association, Boston, W. H. Sayward, 77 Summer St., Secretary; The Builders' Exchange, Akron, O., P. P. Gott, 213 Second National Bank Bldg., Secretary; The Builders' Association, Chicago, Ill., T. M. Craig, Secretary, Chamber of Commerce Bldg.; The Contractors' Association of Public Works, Cincinnati, O., Frank Polking, 110 Odd Fellows Temple, Secretary; General Contractors' Association, Louisville, Ky., George A. Brinke, Secretary, 400 Realty Bldg.; General Contractors' Association, Memphis, Tenn., E. W. G. Meers, Secretary, Scimitar Bldg.; Northern California Contractors' Association, C. H. Gray, Merchants' National Bank Bldg., San Francisco, Secretary; Builders' and Contractors' Association, Norfolk, Va., K. D. Briggs, 231 Arcade Bldg., Secretary; Builders' Exchange, Pittsburgh, E. M. Tate, 270 Fulton Bldg., Secretary; Master Builders' Exchange, Harry C. Woods, 18 S. 11th St., Secretary; and Master Builders' Association, Wilmington, Del., James E. Stein, No. 4 West Ninth St., Secretary.

FINANCING

If your club is started with a constitution and regularly elected officers and a dozen or more members it can easily be financied by the collection of a very moderate initiation fee of from one to five dollars each from the members, plus the dues for the first year if necessary or a small assessment if preferred.

If the formalities are dispensed with a few five dollar contributions from men interested in the idea will be amply sufficient to pay for postage, stationery and typewriting and for the rent of the meeting place if the latter cannot be donated by some one interested in the movement. The officers will doubtless serve without compensation and care should be taken to elect a secretary who has a regular stenographer or typewriter who can easily take care of the minutes of the meeting and send out notices without involving any expense to anyone.

LIBRARY AND MEETING ROOM

One of the first things should be the commencement of a library by invitation to members to donate books, drawings, pictures, specifications and files of periodicals and current publications as fast as they are read.

A circular letter should also be addressed to similar organizations and technical societies throughout the country requesting them to donate copies of their publications in exchange for any publications that you may or may not be able to produce in the future.

Local papers will probably be willing to give a free copy of their paper and thus a considerable amount of valuable and interesting reading matter can be secured and maintained and can afterwards be supplemented by subscriptions when the club can afford it.

This of course can only be accomplished if the club has a regular meeting place where there should be one or more tables and cases provided and supplied with stationery and pen and ink, thus making it a very convention place for members to consult files, to write an occasional letter or hold conferences that are not convenient in their office.

This implies a locked room with a key for every member or, when the club can afford it, an attendant who may have the privilege of carrying on some unobjectionable occupation and be paid a nominal sum for his light services.

Immigration Notes

The Chamber of Commerce of the State of New York went on record January 20 in favor of the Johnson bill to restrict immigration for one year and adopted resolutions for support of the bill as an emergency measure pending the preparation of perfected legislation to give the United States a system of selective immigration.

A new plan for regulating immigration to the United States and differentiating desirables from undesirables at the source has been presented to the Senate Immigration Committee by Harry A. McBride, chief of the vise section of the State Department. He recommended the creation by the government of a commission to have general supervision of immigration and to work in co-operation with the existing agencies of the State and Labor Departments.

The commission would direct immigrants to places in the United States where they were most needed. The problem of selection would be solved by using the vise system and having American consuls abroad write the prospective immigrant's occupation, destination and other qualifications as a part of the passport vise.

National Federation of Construction Industries Opposes Johnson Immigration Bill

The National Federation of Construction Industries has sent out an urgent appeal signed by President Ernest T. Trigg, presenting the principal features of the Johnson Immigration Bill that has already passed the House of Representatives and is now being considered by the Senate Committee on Immigration, and showing why the bill is unnecessary and injurious.

The Johnson Bill proposes the complete exclusion of immigrants for twelve months, thus making a dangerous entering wedge, jeopardizing all future supply of alien labor that will always be so much needed in this country. It makes permanent the present onerous war-time passport restrictions. It is destructive rather than constructive and would operate to admit non-productive classes and exclude strong and willing workers that are needed. The report of the House Committee was biased in favor of the exclusionists and disregarded the needs of all industries, including agriculture, for able-bodied labor and the bill was railroaded through the House of Representatives without consideration of its effect on industry in the United States.

Official statistics published after the bill had been passed by the House of Representatives, show that for the fiscal year ending June 30, 1920, the net gain by immigration was 141,686, of which only 9,877 were permanent alien male population. In 1920 the unskilled laborers emigrating exceeded those immigrating so as to cause a net loss of 102,088.

The immigration committee intends to promote the enactment of liberalized legislation which will exclude the unfit, dependent and non-producing classes and admit the strong, healthy, able-bodied workers that are essential to the economic system of the United States because very little unskilled labor is to be found among American-born citizens who are educated to higher standards of occupation. The Johnson Bill is a dangerous menace and considered to be the entering wedge of the exclusionist policy fostered by enthusiasts and backed by organized labor.

Exaggerated Estimates of Unemployment

An article recently appeared in "Labor" in which it was claimed that there were, on January 1, 2,325,000 unemployed industrial workers in this country, including: Building trades, 300,000; automobiles, 250,000; textiles, 225,000; clothing, 150,000; railroads, 200,000; steel and iron, 150,000; shipping, 125,000; food products, 100,000; amusements, 75,000; metal mining, 50,000; shipbuilding, 50,000; rubber, 50,000; shoe and leather, 50,000; printing, 50,000; casual labor, 50,000.

Frank Morrison, secretary of the American Federation of Labor, says that reports just received from labor officials in 141 cities show the total number of unemployed in those places to be 1,819,272.

The unemployed in New York are claimed to be 300,000; Detroit, 150,000; Philadelphia, 235,000; Baltimore, 20,000; Chicago, 200,000; Cleveland, 118,000; St. Louis, 4,000; Boston, 50,000; Milwaukee, 40,000; San Francisco, 15,000; Seattle, 9,000; and Pittsburgh, 20,000.

---

500 Indictments Expected

It was announced January 24, that "at least 500 indictments, and possibly more, may be expected before the Lockwood building investigation concludes. . . . The indictments will probably be returned within a month or two. Up to the present time 150 indictments have been handed down by the State and Federal Grand Juries. Trials are expected to begin in the state courts shortly, with as many cases on trial at the same time as the available judges and court accommodations will permit."

According to the "Industrial News Survey," the official organ of the National Industrial Conference Board, the peak, on January 15, of unemployment in the industries of the United States appeared to have been passed. Resumption of operation is announced by many plants that were shut down at the end of the year, and increased operation has begun in others that have been working on short time. The movement is not yet believed to be of a very decisive character, but it has been sufficient to check the slow but steady increase of unemployment that has been manifest during the past six weeks. Several large industrial centers report less unemployment than a week ago.

Recent Legal Decisions

INJURY ON STREET—PROXIMATE CAUSE—NOTICE OF DEFECTIVE CONDITION

The burden of proof of negligence as the proximate cause of an injury on a street, for which a city and its repair contractor is being sued, rests on the plaintiff. In such an action for injuries to a woman who stepped into a hole or sink over an old catch-basin, the Texas Court of Civil Appeals holds, Peterson v. City of Houston, 224 S. W. 580, that evidence that the street repair contractor's failure to plug a pipe might have been the cause of the sink was insufficient to take the case to the jury. Assuming that the evidence was reasonably sufficient to carry the case to the jury on this point, it was held that on the authority of City of Houston v. Vatter, 23 Tex. Civ. App. 298, the plaintiff could not recover. In that case it was held that a city charter provision that a city shall not be liable for injuries caused by streets being out of repair unless they shall have so remained ten days after notice to the city in writing, is valid and a bar to recovery where the required notice has not been given.

ONE-WAY STREET ORDINANCE FOR AUTOMOBILES HELD VALID

The Kentucky Court of Appeals, in Commonwealth v. Nolan, 224 S. W. 506, holds that, in view of Ky. St. Supp., par. 3562, giving councils in cities of the fourth class exclusive control over streets, an ordinance of such a city, confining the operation of all motor vehicles on one of its streets, between specified streets, to travel in one direction, on account of the narrowness of such street, is a valid exercise of the police power, not being special legislation or discriminatory. Such an ordinance, designed to protect the safety or health of the public, and necessary for its protection, will not be declared invalid by the courts merely because its enforcement will subject to inconvenience a single person, a considerable number, or an entire community of persons. Whether such an ordinance is valid or otherwise had not been passed on before in Kentucky. The court held that it could not be unconstitutional merely because it legislates solely upon the operation of motor vehicles, and failed to regulate the operation of all other vehicles using the same street. It cited authorities in other jurisdictions authorizing the exclusion of automobiles from certain streets, but refused to go as far as to hold that they might be wholly excluded from the use of any road used by other vehicles.

PURCHASE OF LAND FOR WATER WORKS BEYOND FIVE-MILE LIMIT INVALID UNDER CITY CHARTER

The Oklahoma Supreme Court holds, Brady v. Hurbard, 192 Pac. 567, that where a city of that state is granted a charter form of government and adopts a charter for its municipal government, such charter constitutes the organic law or constitution of such city in its municipal affairs, and the powers, rights, and limitations which the people of such city vote to themselves in the adoption of such charter are binding upon them until amended or repealed. Where a city charter contains a provision which limits the city, in the purchase or lease of land for a water works system, to within five miles from the city limits, a proposition to vote bonds for the purchase of lands beyond such five-mile limit is invalid. In this case it appeared that property sought to be purchased by the city of Tulsa for water works lay some 55 miles outside of the city limits. It was held that under the provisions of the city charter the proposition was invalid.

OFFICERS PERSONALLY LIABLE FOR FAILURE TO REQUIRE PUBLIC WORKS CONTRACTOR'S BOND

The Michigan Supreme Court holds, Lake Shore Stone Co. v. Westgate, 179 N. W. 264, that officers of a municipality who fail to require a contractor's bond in letting a contract for the construction of public buildings or other public works, as required by the Michigan statute, are personally liable to laborers and materialmen injured thereby. In a materialman's action against members of a town board for failure to require a contractor to give such a bond, it was held no defense that the board had been advised by the materialman's agent, with whom it had no legimate business to transact, that a bond was unnecessary, where the members had sufficient knowledge to put them on inquiry as to its necessity.

CITY NOT LIABLE TO TRAVELER ASSUMING RISK IN FOG

The Washington Supreme Court holds, Thompson v. City of Bellingham, 192 Pac. 952, that a city which has been forbidden by the state public service commission to place barriers nearer than five feet to the rails of a street car track leading off a street onto a trestle is not liable for injuries suffered by a traveler who, knowing the situation, drove onto the trestle in a dense fog.

PUBLIC WORKS CONTRACTOR'S BOND DOES NOT COVER EQUIPMENT RENTED AND NOT USED

The Oregon statute requiring a public works contractor's bond concerns every approximate relation of the contractor to the work which he has contracted to do. But it is the labor and material supplied for the prosecution of the work which is protected and not some obligation incurred by the contractor which does not approximate the construction contracted to be done. The Oregon Supreme Court holds, City of Portland v. O'Neill, 192 Pac. 909, that the statute should not be interpreted so as to permit a contractor on public work to lease an equipment and use it for a short time or not at all, abandon the work without returning the rented apparatus to the lessor, and allow the rental to accumulate for a long time, and be counted as an expense protected by the statute and bond. Such is not the letter or spirit of the law.

Pavements Laid During 1920

In the issue of February 5 we published data from about six hundred cities giving conditions throughout the country as to labor; also information concerning failures of pavement bases in several hundred cities. At the time of collecting this information we also obtained figures of the amount of each kind of pavement laid in the several cities, but for these there was no room in that issue. We will give them in tabulated form in the next few issues of PUBLIC WORKS, beginning with this one.

The figures refer to the pavement laid in city streets only, and not roads outside of cities. (The latter will be treated of separately in a few weeks.) The kinds of pavements include, besides those given on this page, tar macadam, Amiesite, stone block, brick, wood block, concrete, plain macadam, and gravel. Future issues will contain figures for these, as well as those for all pavements which were not received before January 20, at which date tabulation of this table was begun.

PAVEMENT LAID DURING 1920

Quantities are square yards or miles unless otherwise indicated

Cities and States	Sheet Asphalt	Asphalt Concrete	Tar Concrete	Bitulithic	Bitoslag	Rock Asphalt	Warrenite	White	Asphalt Macadam
Alabama									
Andalusia				27,000					
Bessemer				10,000					
Arizona									
Tucson				25,691.55					
Arkansas									
Ft Smith		25,000							
Little Rock		4,000							
California									
Bakersfield							77,390		
Napa									9,040
Oroville									
San Francisco	63,492	138,107					23,975		
Santa Monica	26,714			160,949					
Venice	½								
Colorado									
Denver		154,500						9,900	
Pueblo				43,915					
Connecticut									
Hartford	16,000								
Meriden					8,025				
New Haven	78,685	6,895							29,980
Orange	13,500								6,500
Putnam									1,500
Southington							6,000		
Wallingford		10,000							
District of Columbia									
Washington	49,227								
Georgia									
Albany		51,000							
Atlanta								25,000	
Idaho									
Idaho Falls				175,000					
Rupert				28,000					
Illinois									
Chicago	120,363	345							210,730
Joliet		2,235							
La Grange		110,000							
Winnetka									1,400
Indiana									
Bicknell	23,264								
Elkhart	19,700								
Fort Wayne	54,661	23,489							
Gary	95,043.94								4,048.7
La Porte	19,183.5								
South Bend	101,846	64,012							2,235
Iowa									
Albia				19,900					
Cedar Rapids		13,869.54							
Charles City		60,000							
Cherokee	70,434								
Davenport		81,277							
Fort Dodge	30,150	27,450							
Reinbeck				40,000					
Villisca		29,880							
Waverly				15,000					
Kansas									
Osawatomie		17,913.3							
Wichita	114,777	103,817							
Winfield	6,300	1							
Kentucky									
Owensboro		48,000							
Richmond	2½								
Louisiana									
South Highlands		20,000							
Maine									
Bangor			2,900						
Portland		4,650.9							
Massachusetts									
Andover									1-3
Attleboro		3.73							1,250
Boston	52,383	58,804		12,296					
Braintree		½							¼
Brockton		6,581							18,040
Brookline				7,926					
Chicopee									1,480
Lexington									28,399.5
Lynn						3,220			
Wakefield									6,500
Waltham									50,000

(To Be Continued)

NEWS OF THE SOCIETIES

Feb. 14—AMERICAN ENGINEERING COUNCIL. Technology Club, Syracuse, N. Y. Headquarters at Onandago Hotel.

Feb. 14-16 — NATIONAL CIVIC FEDERATION. 21st annual meeting, Hotel Astor, New York.

Feb. 14-16 — AMERICAN CONCRETE INSTITUTE. Annual meeting. Auditorium Hotel, Chicago, Ill. Secretary, Harvey Whipple, New Telegraph Building, Detroit, Mich.

Feb. 15 BUFFALO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Feb. 15—COUNCIL OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Technology Club, Syracuse, N. Y.

Feb. 15-17 — PROVINCIAL ASSOCIATION OF CONTRACTORS AND SUPPLY DEALERS OF ONTARIO. Startford, Ont.

Feb. 16-18 — AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Seventh midwinter convention. Engineering Societies' Building, New York City.

Feb. 21-23 — MINNESOTA SURVEYORS' AND ENGINEERS' SOCIETY. Annual convention. Hotel Commodore, St. Paul.

Feb. 25-26—CONSTRUCTION DIVISION, U. S. ARMY. Annual reunion of those identified with this division during the war. Morrison Hotel, Chicago, Ill.

Feb. 28 — PHILADELPHIA SECMECHANICAL ENGINEERS. Engineers' Club of Philadelphia.

Feb. 28 — CHICAGO SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

March 11-12 — NORTHWESTERN ASSOCIATION OF GENERAL CONTRACTORS. St. Paul Hotel, St. Paul, Minn.

March 14—AMERICAN ASSOCIATION OF ENGINEERS. The third annual railroad conference. Chicago.

April 27—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention. Houston, Texas.

April 27-29—UNITED STATES CHAMBER OF COMMERCE. 9th annual meeting. Atlantic City, N. J.

May 9-11—AMERICAN ASSOCIATION OF ENGINEERS. 7th annual convention. Buffalo.

May 17-19—NATIONAL FIREMEN'S ASSOCIATION. Twenty-third annual convention. Fort Wayne ,Ind.

June—CONFERENCE OF MAYORS AND OTHER CITY OFFICIALS, State of N. Y. 12th Annual Conference. Elmira, N. Y.

June 6-10—AMERICAN WATER TER WORKS ASSOCIATION. Annual convention at Cleveland, Ohio. Secretary, J. M. Diven, 153 West 71st St., New York.

June 7-9—NATIONAL FIRE PROTECTION ASSOCIATION. Annual meeting. San Francisco, Cal.

Oct., 1921—IOWA SECTION, AMERICAN WATER WORKS ASSOCIATION. Seventh annual meeting.

SEVENTH ANNUAL ROAD SCHOOL OF PURDUE UNIVERSITY

The seventh annual road school of Purdue University, co-operating with the Indiana County Highway Superintendents' Association and the Indiana State Highway Commission, was held at the University of Lafayette on January 18, 19 and 20. The topics especially considered were: Road maintenance, road systems, testing and inspection of roads and road materials, and highway transportation.

MID-WESTERN HIGHWAY AND TRANSPORT EDUCATION CONFERENCE

Under the auspices of the Permanent Committee on Highway and Highway Transport Educaation, the University of Michigan and the Michigan State Highway Department, a Mid-Western Conference on Highway and Highway Transport Education, will be held in Ann Arbor, Mich., Rebruary 23.

Program: 10 a. m., "The Highway and Social and Economic Welfare," by Dr. P. P. Claxton, chairman of the Permanent Committee; "The Educational Activities of the Permanent Committee," by Professor C. J. Tilden, director of the Permanent Committee; "The Economics of Highway Transport," by Roy D. Chapin, vice-president, National Automobile Chamber of Commerce; "Highway and Highway Transport Education in Secondary Schools," by George C. Diehl, chairman, Good Roads Board, American Automotive Association; "Safety First Education in Secondary Schools," by Harriet E. Beard, supervisor of safety education, Detroit Public Schools.

2 p. m., "The Measure of Highway Accomplishment," by Thomas H. Macdonald, chief, United States Bureau of Public Roads; "The Army's Highway Transport Problem," by Col. Mason M. Patrick, Corps of Engineers, U. S. Army; "The Inter-relationship of Waterway, Railway and Highway Transport," by Professor Henry E. Riggs, Professor of Civil Engineering, University of Michigan; "Snow Removal from Transport Routes," by Charles J. Bennett, State Highway Commissioner of Connecticut; "The Economic Value of Highway Transport Surveys," by Professor Arthur H. Blanchard, Professor of Highway Engineering and Highway Transport, University of Michigan.

Dinner in the banquet hall of the Michigan Union, 6 p. m. After dinner addresses: "Highway Transport and the Industry," by Tom Synder, secretary, Indiana Highway Transport and Terminal Association; "Inter-relationship of Highway Transport and the Back-to-the-Farm Movement," by A. R. Kroh, Development Department, Goodyear Tire and Rubber Company.

8:30 p. m., concert by the University of Michigan Band; address, "The Trinity of Transportation," by the Hon. William C. Redfield, former secretary of Commerce of the United States; "What's Your Hurry," Wallace Reid in a motion picture story of highway transport.

IOWA ENGINEERING SOCIETY

A meeting of the Iowa Engineering Society was held on January 18-20 at Des Moines, and was well attended, more than 400 engineers and their friends being present and 40 exhibitors. The three sections, municipal, drainage, and highway, held their meetings simultaneously.

The society voted unanimously to become a charter member of the Federated American Engineering Societies. The State Legislature was petitioned equipped geological survey. Standard forms for engineering contracts, paving, sewers and water works were submitted by a committee of that name headed by M. G. Hall.

The following officers were elected for next year: President, J. H. Dunlap; vice-president, Alvin Le Van; and new director, J. D. Wardle. The successor to Mr. Dunlap, who was secretary of the society since 1914, will be chosen by the board of directors.

VIRGINIA GOOD ROADS ASSOCIATION

The annual meeting of the Virginia Good Roads Association was held in the Hotel Roanoke, Roanoke, Va., on January 26, 27 and 28. The principal topics of discussion were highway problems in Virginia and the opportunity for greater road development in the state as a result of the adoption of the good roads amendment to the state constitution. Among the speakers were D. D. Hull, Jr., president of the Lee Highway Association; James W. Brooks, director of the educational bureau of the Federal Highway Council; Wade H. Massie, chairman of the Virginia State Highway Commission; George P. Coleman, stat highway commissioner of Virginia; and C. C. Vaughn, Jr., president of the Virginia Good Roads Association.

MECHANICAL ENGINEERS

The spring meeting of the American Society of Mechanical Engineers will be held at the Congress Hotel, Chicago, May 23-26.

Sessions are planned by the Professional Sections on Aeronautics, Fuels, Management, Material Handling, Machine Shop, Power, Forest Products and Railroads.

ST. PAUL ENGINEERS' CLUB

At the annual meeting of the St. Paul Engineers' Club on January 10 the following officers were elected: President, John H. Mullen, deputy commissioner of the State Highway Commission; vice-president, W. W. Walker; treasurer, William N. Carey; member of the Minnesota Joint Engineering Board, William C. Armstrong.

PERSONALS

Blanchard, A. H., consulting highway and transport engineer, Ann Arbor, Mich., has been retained by the city of Colorado Springs in connections with its $1,200,000 paving program.

Searcy, Victor, has been appointed county engineer of Wood county, Tex., to succeed S. B. Davis, who resigned.

Shafer, Wallace H., has been appointed road superintendent of Armstrong and Clarion counties, Pa.

Morarity, Maurice P., has been appointed assistant city engineer of St. Paul, Minn., and will be in charge of street grading, sewer and sidewalk work.

Myles, L., of Toronto, has been appointed county engineer of Victoria county, Ont., with headquarters in Guelph.

Edwards, Llewellyn N., has been appointed bridge engineer of the State Highway Commission of Maine, with headquarters at Augusta.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

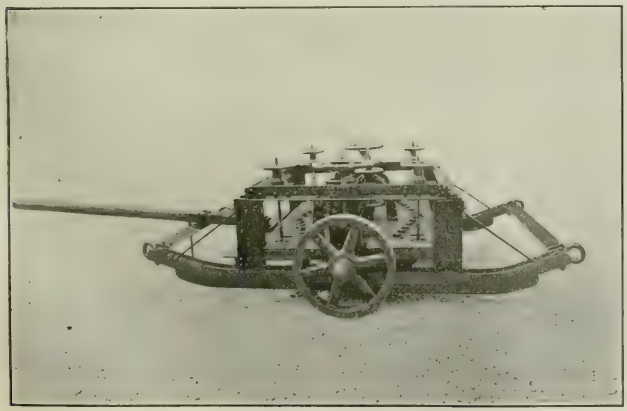
ROAD PLANER DRAWN BY TRACTOR IN SERVICE

KINNEY ROAD PLANER, JONES PATENT

This machine is the invention of Richard A. Jones, for many years street commissioner of the city of Waltham, Mass. The Kinney Manufacturing Co. has acquired full rights for the manufacture and sale of this equipment.

The Kinney road planer is especially designed for use on bituminous roads and highways. It is adapted for planing or leveling the waves or ridgy elevations that frequently appear on the road surface. The machine is a combination drag, planer and scarifier, constructed entirely of metal, and weighs about three and one-half tons. It may be drawn by a steam roller or tractor. The machine is mounted on steel runners equipped with removable cast iron shoes and of ample length to cover or cross the road waves without following the contours of the surface. Upon the runners is mounted an oscillating iron plate, holding the planer knives and scarifying chisels or picks, all adapted for adjustment by hand-operated screws to meet the varying conditions of the road surface. For moving the machine to a distance or from one job to another, steel wheels are provided, equipped with lifting screws by means of which the entire machine may be raised upon the wheels for transportation. When in actual service, the machine is lowered and moved upon the runners. The machine has a double equipment of picks or planer knives and may be drawn backwards or forwards without being turned upon the runners.

This machine removes the bunches or ridgy elevations from the road surface without destroying the general contour of the road. The facilities for adjustment of the scarifiers and planers in any desired angularity or depth of cut, will fully meet the different conditions arising from changing temperatures or varying viscosities of the material used in the construction of the road. While designed especially for use on bituminous surfaces, the planer may also be used to good advantage on macadamized or dirt roads.



ROAD PLANER SWUNG FROM TEMPORARY WHEELS FOR TRANSPORTATION

In the New Hampshire Highway Department, where this machine has been thoroughly tested under severe conditions, it has been shown that, by the use of oil macadam during the past season, a saving of many thousands of dollars has been effected as compared with the expenditures involved in the usual method of reconstruction and renewal.

PIPE MACHINES

A catalogue just issued by the Williams Tool Company illustrates eight pipe and bolt threading machines for diameters of ⅜ inches and up to 18 inches. All of them have rigid cast lathe beds which, for the smaller sizes, are supported on braced legs and for the larger sizes on short pedestals or are seated directly on the foundation. All are furnished with belt drives and all but the two smallest sizes can be furnished with motor drives. The catalogue gives general description and specifications of each machine, together with numbered illustrations of spare parts to facilitate repair orders. The No. 1 machine with a capacity of ¼ inch to 2 inches is furnished with a crank for hand power, No. 1 and No. 2 have cutting off attachments.

IMPERVITE WATERPROOFING

A bulletin issued by the Standard Paint Company describes the uses and advantages of Impervite, which is a white paste with a paraffin base and is shipped in 25-pound and 100-pound cans and 450-pound barrels, recommended for use in waterproofing floors, walls and mass concrete. Specifications are given for its mixture with cement mortar and application as a permanent coat to the inner surface of concrete construction, for its application and mixture with the cement and aggregate in mass concrete, and for mortar used in non-cracking stucco.

ALL-STEEL DUMP BODIES

The Providence Body Company has issued a folder illustrating an all-steel dump body that can be used as an ordinary dump body with tail gates swinging from the top for stone, sand, gravel or other heavy materials. When the body is required to carry coal, a side extension may be used. If the body is to be used for lumber or other bulky materials, the sides can be removed and tail gates suspended at floor level.

Specifications call for the floor to be covered with 10-gauge steel, the tail gates to be hinged at top and bottom, and the tail gate opening device to be operated from the front of the body. The standard sizes are 9 x 5 feet, 10 x 6 feet and 10½ x 6½ feet. All of them are 27 inches high and with capacities of 54, 81 and 108 cubic feet, that can be increased by a 4-inch extension to 70, 100 and 125 cubic feet and by a 12-inch extension to 99, 140 and 170 cubic feet. All-steel dump bodies without extension sides and operated by Wood hydraulic hoists that are made of capacities from 54 to 215 cubic feet.

HAND DUMPING 1-TON TRUCK

ONE-TON TRUCK DUMP

An improved Ford dump mechanism, known as the Ford standard speed dump, has been perfected by the Standard Steel Works. It is designated for one-ton Ford trucks and is adapted particularly for quick hauls. The dump is operated from the driver's seat by a hand lever. No mechanism is connected with the truck power. An automatic locking device prevents the body from slipping back and the contents can be dumped at will by operating the hand lever.

In concrete work, crushed rock and sand can be mixed in loading the truck and dumped direct into the mixer. Cement can then be added and the batch is ready to mix. The new dump eliminates shoveling and wheeling to the mixer and saves waste of material. The capacity of the steel body varies from 27 to 40½ cubic feet, and it has a total weight of 450 to 550 pounds. The dumping device alone weighs 165 pounds. The dump can be installed on any Ford truck chassis in ten minutes.

INDUSTRIAL NOTES

Murdock, R. B., has resigned as executive engineer of the Asphalt Association and now represents the F. D. Cummer & Son Company of Cleveland and New York, manufacturers of asphalt paving plants and driers. The heavy demands for Cummer plants have necessitated this and other additions to their regular organization. Mr. Murdock has offices at 19 West 44th street, New York City, and is concerned with Eastern domestic and export sales.

CIVIL ENGINEERING FIRM ORGANIZED

Robert E. Horton, Harry Barker and Robert C. Wheeler have become associated under the firm name of Horton, Barker & Wheeler, to continue their consulting engineering practices formerly carried on under the names of Robert E. Horton, Consulting Hydraulic Engineer, Albany, N. Y., and Harry Barker and Robert C. Wheeler, Engineers, New York City.

The new firm will have its headquarters in Albany, with offices in New York and Harrisburg, Pa., and engineering laboratory at Voorheesville, N. Y., and will specialize in power development and transmission, water supply, sewerage and sewage disposal, public utility rates and valuation.

Joel A. Thayer, for the past thirteen years superintendent of streets of the city of Taunton, Mass., has resigned to become the New England manager of the Acme Road Machinery Co., of Frankfort, N. Y., and assume the management of their Boston office at 141 Milk street, succeeding the late Wm. T. Becker, who had filled this position for many years past, and whose death occurred very suddenly on December 3 last.

S. J. Lehner, president of Lenher Engineering Co., New York, who assumed the general management of S. Flory Manufacturing Company, Bangor, Pa., upon the death of Mr. Samuel Flory, has been elected president of S. Flory Manufacturing Company, and will direct its affairs from the home office at Bangor.

The Austin Machinery Corporation of Louisiana, Inc. ($300,000 capitalization) announces its incorporation under the laws of the state of Louisiana, as sole distributors for Louisiana, Arkansas, Mississippi, Tennessee, of the products of the Austin Machinery Corporation, manufacturers of contractors' equipment. This corporation will carry a full stock of machinery and spare parts for this territory, serving with dispatch the requirements of municipalities and contractors of excavation, construction, irrigation and drainage projects. General offices, 1020 Maison Blanche building, New Orleans, La.

The Goulds Manufacturing Co., Seneca Falls, N. Y., manufacturer of pumps, has appointed Edward S. Jenison as acting sales manager to succeed W. E. Dickey, who is retiring from business.

Increased efficiency of sawmill and woods labor in all sections of the south is reported by the Southern Pine Association. Notwithstanding reductions which have been made in the number of men employed by the companies, an of men employed by the companies, an increase in the output is shown. The number of colored men seeking work is much larger than heretofore, this being attributed to the fact that the negro is gradually realizing that he does not fit into northern industries and is returning to his old clime.

PERSONALS

Raymond, Fay M., has accepted a position as supervising engineer in charge of paving work in Neosho county, Kan.

Klorer, John, for eight years assistant state engineer of Louisiana, is now city engineer, New Orleans La.

Evans, A. M., has resigned as city engineer of Norwich, N. Y.

Worrell, Capt. M. L., who was for three years in the Utilities Section, Construction Division of the U. S. Army has received his discharge, and has taken a position with the U. S. Bureau of Public Roads as highway engineer.

Arnold, Dr. Craig, has been appointed engineer for the State Highway Department of Georgia.

Wise, Russell, of Passaic, N. J., has been appointed city manager of Clifton, N. J.

Witter, George, of Ida Grove, Ia., has been appointed county engineer of Ida county, Ia.

Carlisle, John N., formerly state highway commissioner of New York, will take a new position as head of the Northern New York Utilities Co., of Watertown, N. Y.

Benson, S., has resigned as state highway commissioner of Oregon, and John B. Yeon appointed a member of the same commission to fill the vacancy left by Mr. Benson.

MacStay, Arnold B., has resigned as street cleaning commissioner of New York City and has accepted a position as deputy commissioner of public welfare.

Thourot, Harry, recently with the Hudson county engineer, has been appointed town engineer of Union Hill, N. J.

Sylvester, E. W., has resigned as superintendent of public works and city engineer of Poughkeepsie, N. Y., to enter the Pennsylvania State Highway Department.

Wyse, F. C., has resigned his position as city engineer of Columbia, S. C., to enter the engineering and contracting business.

Tomlinson, W. S., has been appointed city engineer of Columbia, S. C.

Harris, John K., has been appointed borough engineer of Sharon, Pa.

Davis, E. R., has been promoted to the position of chief engineer of Newport News, Va.

Tuttle, Arthur S., deputy chief engineer of the Board of Estimate and Apportionment, New York City, has been appointed chief engineer, to succeed Nelson P. Lewis, resigned.

Sission, Herbert S., state commissioner of excise since 1917, has been appointed New York State Highway Commissioner, to succeed Col. Frederick S. Greene, who resigned.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879

Vol. 50 FLORAL PARK, FEBRUARY 19, 1921 No. 8

Some Observations and Facts Concerning Motor Sweepers

By John T. Child*

Some facts, figures and suggestions for operation presented by an engineer of the Rochester Bureau of Municipal Research. Details of construction and operation of the different makes. When the use of such sweepers is financially advisable.

Motor street sweepers have unquestionably proven themselves and have come to stay. There are only two companies making this kind of equipment. The Elgin Street Sweeper Company first demonstrated motor sweeping in 1913 and its machines were put into general use during the war. We are told that the first machine built by the Austin Company was sent to France to do special work. Since then both machines have been greatly improved and their sale and use has increased rapidly. This kind of sweeping equipment has solved a difficult labor problem at reduced costs and undoubtedly has a very bright future before it in the street cleaning field.

Motor sweepers perform three operations simultaneously—they sprinkle, sweep and pick up the street dirt. In the past these operations required a team and driver with a sprinkling cart, about 12 sweepers with push brooms or scrapers and a pick-up wagon with a team, driver and two men. Motor sweepers do not sweep up the very fine dust and hence cannot take the place of motor flushers. However, they can be worked to great advantage by following over a smooth flushed street several hours later. In such cases it is necessary to sweep the gutters only and in this way they can pick up the dirt washed toward the curb by the flushing operation and cover a greater number of streets. When this is done, the area sweep should be figured from the miles swept and not from the total width of street.

Successful and economical motor sweeping depends on several factors which must be taken into consideration if good results are to be obtained. The original outlay for equipment is rather high and the motor sweepers have a good many moving parts requiring frequent and careful attention. If good mileage is to be obtained the sweepers must be run over regular routes and be kept going. In this regard routes should be laid out with as few reverse turns as possible as it takes nearly as long to turn around at a dead-end street as it does to sweep a full block.

Naturally motor sweepers do their best work on pavements in good condition, especially brick and asphalt, but they do excellent work also on block pavements and in car-track areas. Rough pavements are always harder to clean than smooth ones and hence are sure to cost more. If pavements are rough, going over them with heavy motor equipment shakes up the apparatus a good deal, wears the brooms rapidly and progress must necessarily be slower than on good pavements. Hence the costs will be higher.

Unit costs should be based upon miles traveled rather than on miles swept because so much depends upon the way the route is laid out. However, it should sweep as it goes if routes are laid out to the best advantage because if a machine has to go two miles before it starts sweeping and returns two miles running idle, nearly an hour's sweeping time is lost, which reduces its possible daily sweeping area 15,000 yards or more. No attempt will be made herein to give accurate cost data because figures received from about 20 cities are in no way comparable because there is no uniform practice of cost keeping and the whole truth is not known even by the person who compiles them as best he can. The range including overhead is from 12 to 30 cents per 1,000 yards, which is cheaper than hand work.

There are two makes of machines on the mar-

* Assistant engineer, Rochester Bureau of Municipal Research.

ket. The Austin sweeper and the Elgin, both of which have a gutter broom attachment which sweeps the heavy dirt from the curb out under the main broom, which in turn sweeps all the dirt on to a conveyor that raises it up to the top of a hopper. The Elgin Company also makes a separate motor sweeper without any conveying or hopper equipment. This machine has its broom at an angle similar to a horse-drawn broom, which sweeps the dirt into a windrow on the left side, from where it can be picked up by a separate pick-up sweeper. Of course the first cost of this machine and the operating expense are both less than for the larger pick-up unit. While it does not sweep as wide a swathe the unit cost per 1,000 yards is appreciably less. This machine must, of course, be used in co-operation with the pick-up sweeper or else the material must be piled and loaded by hand, which is not an economical plan.

Operator—The operators for these sweepers should be good motor truck drivers and also men who will take interest in what they are doing. There are a good many things to look out for and the cleaning value of the work depends very largely on the operator. It is necessary that he keep as close to the gutter as possible and on this depends the real success of the equipment because most of the dirt is to be found in the gutter.

The wages paid in 1919 and 1920 for drivers of this kind of equipment ranged from $3.50 to $6 a day, depending on the city, almost all of them being paid $5 a day. It is possible for one man to operate either Elgin or Austin sweeping machines. However, for the Austin machines, some cities use a helper and others pay the driver a little higher salary if he will do the work without a helper. Some of them pay the driver a bonus for not having much lost time due to breakdowns. In other words, they make it worth while for the driver to take care of his machine and keep it in good running order. This is most important if good consistent results are to be obtained.

Helper.—If a helper is used on the Austin machine he should be a good lively laborer who can jump off the machine, run ahead and pick up stones, boards or other obstructions which will prevent the machine from doing a complete job or which might cause clogging in the conveyor. On smooth pavements the helper should sit on the right side where he can jump off easily and also raise and lower the gutter broom. On rough pavements the helper should sit on the left side where he can work the rear broom lever, which should be used to get the dirt out of holes and depressions. (This is done by merely pressing forward on the broom lever when a particularly bad place in the street is reached. On the Austin with a left-hand drive it is possible for an expert driver to do this with his foot, but it is good deal to ask of a new man, when he has so many things to think about.) The helper also should release the dumping device and pull over the dirt in the hopper when necessary. He can save time by raising the hopper doors while the driver is backing off the load. A helper can also save time when filling the water tank. $3.40 a day should cover the expense of an extra man.

Hopper.—The hoppers on the machines will hold from two to three cubic yards when level full below the conveyor spout. In practice, however, it is found that the right-hand side of the hopper fills up quicker than the left-hand side because the dirt is much heavier in the gutter. If there is a helper on the machine he can pull the dirt over onto the left side while the machine is in motion, or else the machine may be dumped when the right side becomes full. This may reduce the capacity of the hopper 10 per cent or so. The capacity of the hopper is seldom as important as is finding a desirable place to dump. In other words, if a good dumping place is found before the hopper is full, it is well to dump the load then and there to facilitate removal and to avoid danger from the piles on the street. Sometimes the machine will pass a pick-up wagon and when that occurs it is well to dump the material so it can be picked up immediately.

It was found in timing a number of loads from an Austin machine that it took on an average of four minutes and two seconds to dump a load. The hopper bottoms are worked in exactly the same manner as a bottom dump wagon, and the load is dumped in two separate piles touching at the base. Ordinarily for a full hopper the right-hand pile will not exceed nine feet in length. After the hopper became limbered up it was found to work very satisfactorily and to leave a neat pile on the street. Fairly level ground is necessary for dumping purposes as the clearance is small. The Elgin hopper dumps by letting half the V-shaped bottom swing free. The pile left is only three or four feet long and as wide as the hopper is long. This dumping device is simple and effective.

Sprinkling Devices.—The Austin machine has a 150-gallon water tank and the sprinkling device, containing nine nozzles, is on the bumper. The pressure is regulated from a pump which operates satisfactorily at 50-pounds but which can be increased to 65 pounds if necessary. The tanks can be filled in four minutes, twenty-six seconds, this being the average of twelve loads timed. This period covers the time between the stopping and resuming of sweeping operations. It is usually advisable to fill the tank when the load is dumped even though it may not be entirely empty. If the load is dumped anywhere near a hydrant, the double operation can be completed in less than eight minutes. In the sprinkler system there are water strainers which collect a great deal of the sediment which may come from the hydrants. However, it is desirable to carry a small wire for cleaning out the small holes in the sprinkling nozzles.

The Elgins have 180-gallon tanks tested for 100 pounds pressure. From this tank an atomized spray is delivered from four nozzles from the front of the machine with a pressure maintained and regulated by a compressor driven from the transmission.

The sprinkling devices when once cleaned out work satisfactorily except when the dirt is very heavy, in which case it was found that the dirt on the street absorbed all of the water by the time the machine had run over it. In very heavy dirt there is dust thrown up around the machine which is undesirable and disagreeable. It is believed, however, that if the machines were run over regular routes three times a week this condition would not result. Here again is an example of how the best results can be obtained by properly planning and routing the work of the machines.

Gutter Broom.—The gutter broom first used on the Austin sweeper is made of 24 pounds of split bamboo, each of the 24 U-shaped bundles being bolted on separately. This material proved to be satisfactory except where the dirt is in piles or very heavy or wet. In 1920 it cost from seven and one-half to ten cents a pound before wired into bundles. If it is very wet and muddy all of the material is not swept out the first time over. If the material is in piles some of it is thrown up on the curb and left behind and some of it is thrown out beyond the machine, where it may be taken up on a center trip. A newer design consists of four discs for the gutter brooms which are easier to take apart and refill than the original design. They increase the sweeping width three inches. The company has also designed a different kind of holder so that wire may be used for filling these brooms in place of bamboo. The stock should be made of a 60 to 80 per cent carbon steel. This will have a good deal of spring to it and has been proven more satisfactory and lasting than the bamboo. The bamboo gutter brooms may be used satisfactorily until they are worn down to within four inches of the holder. Gutter brooms of split bamboo were used up after sweeping from 10.2 to 14.7 hours of gutter sweeping or from 41 to 63 miles, depending on the kinds and conditions of pavement and dirt encountered. These brooms can easily be replaced in the field if necessary.

The gutter broom on the Elgin machine is of somewhat different design. The only stock used is wire and the broom is attached by a universal joint which helps the device to conform to the angle of the crown of the pavement so as to meet all conditions.

Rear Broom.—The rear brooms are bamboo filled and are found to work satisfactorily and to wear down evenly so that it is not necessary to reverse their position, as must be done with horse-drawn equipment. The broom may be worn down to within three inches of the guard before being discarded. On rough pavements it is necessary to have the longer bristles (that is a newer broom) in order to get all the dirt. A broom fairly well worn down does excellent work on smooth pavements. It was found necessary for good results to replace the rear broom after from 17 hours to 23 hours of service, during which time it had swept a lineal length of from 61 to 94 miles. The Elgin brooms require 85 pounds of 24-inch fiber while the Austin Company believes in using nearly twice as much. A cable is preferable to rope for winding the brooms.

Conveyor.—The conveyor of the Austin machine will not pick up stones larger than two inches under ordinary circumstances, without risk of shearing off the wooden pins which are placed to prevent any serious damage being done in case the conveyor becomes clogged. The conveyor consists of rubber squeegees operated by chains and is very effective in carrying dirt to the hopper. If there are pools of water in the gutter a surprising amount of mud and water will be carried up into the hopper and remain there. It is claimed that the squeegees will last about three months. At the end of that time it may be necessary to replace them with three-inch strips of rubber or rubber fabric. The conveyor must be watched closely by the driver in order that no damage may come to it. It must be always raised up when the machine is backed up or else the apron which catches the dirt will be crumpled up.

The conveyor of the Elgin sweeper is just the reverse of the Austin. Instead of movable rubber squeegees, they have a movable rubber belt conveyor which actually carries the dirt to the hopper while the squeegees on the Austin push the material up an inclined plane. Both methods are effective.

General.—It has been found a little difficult for a new driver to sweep close to the gutters, but this simply requires practice. When properly operated the gutter brooms do very satisfactory work. The Austin machine can sweep in a circle with a radius of thirteen feet and three inches, while the Elgin, which has only three wheels, can sweep in a circle with a radius of nine feet. It has been found in practice that there is a tendency at corners to leave a segment at the curve unswept. When going around a standing vehicle there is a segment in the gutter for 30 to 50 feet which remains unswept as there is no follow-up sweeping done. This is a bad feature in a way, but it can be minimized and reduced by care and practice and if the machines are run over a regular route these things will not be serious, especially at night.

When a machine passes a private driveway, it is always sure to leave a row of dirt along the entrance to the driveway and there appears to be no way of preventing this. Also when the conveyor is picked up for turning around, some dirt is left on the pavement. If the machine comes back the same way it can pick that up again, but if it goes on there is a small row of dirt left on the pavement.

In all municipal work of this kind there is some difficulty in getting officials to plan their work properly and in having men trained to do things the best way, and to the best advantage.

Motor sweepers must not be considered as a panacea for all street cleaning ills because they will not do everything. However, it has been proven that motor sweepers can sweep consistently at a speed of six or seven miles an hour and do good work at the rate of four miles or more an hour, including turns and stops for dumping

and taking water. The desirable width of a motor sweeper depends on the width of a street, particularly on car track streets. They should be able to pass a trolley on the right. A machine which cannot do this causes considerable delay on such streets. The prevailing width of streets is important also because certain widths make a great deal of unnecessary lapping.

There is no doubt but that both machines are well made and designed, and it has been demonstrated that they will do all that may be reasonably required of them. There are about 250 in use in this country now. The designs are being constantly improved just as any other valuable piece of machinery is improved as time goes on.

WHEN FINANCIALLY ADVISABLE

Many small cities are unable to decide whether they have enough pavements to warrant the purchase of motor sweepers. A good way to arrive at this conclusion is by first figuring the miles of hard paved streets in at least fairly good condition. Then consider that a machine should sweep about 25 lineal miles a day and that probably three trips per street would be the average number of trips on the whole street length. These figures are more or less set and the only variable to be decided upon is the number of times a week the streets are to be cleaned. This should be from three to six. In small towns, which usually have a comparatively small percentage of hard paved streets, it is desirable, if not absolutely necessary, to sweep the streets six days a week because so much dirt and mud is being constantly washed in and tracked in from the many unpaved cross streets.

In a northern climate a sweeper would probably not be used over 200 days a year. This would mean a maximum mileage of 5,000 miles a year. If used to the maximum or near it, the life of heavy equipment of this kind would probably not be over five or six years—depending largely on the care received and replacements made. If the sweeper is kept going, the cost is bound to be less than by hand labor. The comparative costs should be figured somewhat as follows:

The range of motor sweeping figures from about 20 cities show a sweeping cost of from 12 cents to 30 cents per 1,000 yards. These costs include operators, mostly at $5 or $6 a day; six to eight gallons of gas a day; oil and grease at 35 to 48 cents a day; 1,500 to 2,000 gallons of water at 10 cents per 1,000 gallons; gutter and main broom wear from $4 to $8.50; repairs and painting at $3 to $6; supervision at $2 to $3; depreciation at 20 per cent of cost for a 200-day year and interest at 6 per cent. Complete insurance, if taken out, costs about 90 cents per day. Storage cost may be added if desired. The rather wide variation in these costs are due to a few important factors:

(a) The demand for really clean streets;

(b) The manner in which the routes are laid out;

(c) The care given the machine;

(d) The caution and skill used in operating; and

(e) The kind and condition of the pavements. These may affect the area swept daily by over 100 per cent because with the same machine the variations range from 100,000 to a capacity of 280,000 square yards.

The area to be cleaned should be at least in the neighborhood of 100,000 or more square yards. This would mean from seven to ten lineal miles of paved streets averaging 24 feet wide and requiring six cleanings a week. The type and cost of equipment and the mode of pick-up should also be given consideration. The capital outlay will, of course, affect the depreciation, interest and insurance charges. The gas and oil consumption will be dependent on the type of machines used. If gutter brooms are not used, the total broom cost will be reduced as will also the area that can be covered.

Now, what does patrol sweeping with hand brooms actually cost? One man at $4 cannot sweep on the average over 10,000 yards a day under the conditions mentioned.

One sweeper's equipment now costs as follows:

	First cost	Aver. life with repairs	Repairs	Replacements or depreciation	Total
24 in. fibre or 18 in. wire broom	$2.00	4 months	$0.25	$4.00	$4.25
1 No. 6 scoop shovel	1.00	2 years	.25	.95	1.20
6 barrels at $4.50....	27.00	6 years	5.40	4.50	9.90
1 barrel cart about....	2[illegible]	5 years	1.80	[illegible]	6.00
1 barn broom at.....	1.00	3 months		[illegible]	3.00
Total	$56.50		$6.50	$17.45	$23.95
1 man, 200 days at $4.00...					$800.00
Tools					23.95
Total cost					$823.95

200 days times 10,000 yards equals 2,000,000 yards swept.
This area cost $823.95 or $.412 per 1,000 yards.
Add supervision, $.025 per 1,000 yards.
Total cost, $.437 per 1,000 yards.

It can readily be seen that this figure does not compare favorably with motor sweeping costs as it is over 33 per cent higher than the highest figures quoted for motor sweeping. In larger cities "litter patrol" work by hand is absolutely necessary to keep the business streets picked up, but in small towns the business streets are relatively short and can be cleaned by motor equipment when least crowded. Nothing has been mentioned about double shift work. There is no reason why motor sweepers cannot be used two shifts a day as flushers are—the more crowded thoroughfares being cleaned after midnight. This, will reduce capital outlay, interest and insurance, but not other items except the unit cost.

Illinois Federal Aid Roads

More than 700 miles of Federal Aid roads have been constructed in Illinois, including the Lincoln highway across the north end of the state, the Dixie highway paralleling the eastern border, the Old National Trails road across the southern part, and the St. Louis and Chicago road. The two first named are nearly completed while the other two are well advanced. On another Federal Aid road known as Route 10, from Springfield through Decatur to Danville, heavy grading contracts have already been let.

N. Y. Harbor Dry Dock Corporation's Plant*

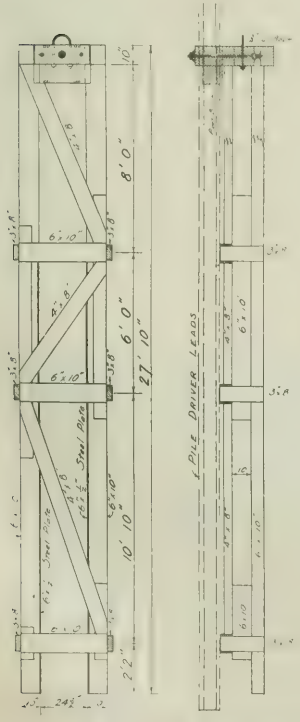
Driving inclined piles, dredging and excavating by special methods around piers. Equipment used by contractor.

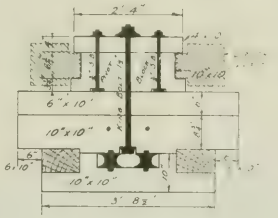
The sheet piles and the inclined piles were driven by a McKiernan-Terry steam hammer operated in swinging leads that, for some of the piles in the piers, were suspended from the tower of the regular floating pile driver. For the sheet piles and the remainder of the spur piles the swinging leads were suspended from the mast or boom of a derrick boat, working on the outer face of the bulkhead line, because in some cases the depth of water was not sufficient for the draft of the regular floating pile driver.

The swinging leads, about 28 feet long, had two 6 x 10-inch guide timbers faced with 6 x ½-inch plates and spaced out clear of the face of the fixed vertical pile driver leads, which engaged a sliding pivot block from which the swinging leads were suspended, and which was itself raised and lowered by a tackle suspended from the top of the fixed leads, or from the derrick boom. The swinging leads were easily attached and detached and were very flexible in operation, permitting the piles to be driven at any angle, and were considered efficient and satisfactory. The pile driver gangs were followed by successive gangs that did the stay lathing, cutting off, capping, placing the stringers and laying the decks, respectively.

(*Continued from Page 143)

ENGLISH SIDE PILE WITH STEAM HAMMER IN SWINGING LEADS





Section through Head.

To Connect Up Lower Hammer to collar of Driver Leads. Turn Pivot Block and remove ¾" Screw Bolts that Swinging leads to pivot casting. Pivot Block is Drive Leads. Can't Swinging Leads, for example, permit removal of ¾" Screw Bolts and Pivot Block. Pass Hammer Cable through Sheaves in head of Swinging Leads and Hammer through bottom of same.

SWINGING LEADS FOR DRIVING BATTER PILES

Concrete for the bulkhead walls was mixed in a Ransome machine mounted on a small scow that was towed from Stapleton about 1 mile away, bringing on it quantities of broken stone, sand and cement sufficient for two days' run. The scow was moored alongside the forms and the mixer was elevated far enough above its deck to discharge through a chute directly into the forms.

DREDGING

The original depth of the water between the piers varied from nothing to 22 feet below mean low tide, and dredging to the required depths of from 22 feet to 33 feet for the wet basins and 44 feet for the dry dock basin, involved the excavation of about 200,000 yards of sand, clay, some hard-pan and occasional boulders. At the commencement of operations a 5-yard clam-shell dredge was used but proved unsuitable for the very hard bottom. Nearly all of the dredging was done by five dipper dredges with dippers varying from 5 yards to 15 yards capacity. The dredged material was delivered to mud scows, towed about 5 miles out to sea, and dumped in deep water. The best dredging record was made by Dreymann Brothers' dredge, Toledo, having a 15-yard bucket and a crew of 18 men. In March, 1920, this machine excavated 40,600 yards of material.

SPECIAL METHOD OF EXCAVATING AROUND PIER PILES

The dry dock pontoons are rectangular in section with flat bottoms, making it absolutely necessary for the dredging to be carried down to grade close to the piers. The result of building the piers before the dredging was finished was that there were places which the dredge could not reach where the ground elevation had to be lowered considerably. The difficulty was overcome by having the dredge dig to 4 or 5 feet below grade as close to the piers as possible, so that the material beyond its reach would slide down into the hole it had made and thus make grade on the required line.

At the angle at the inner end of Pier A (marked X on the plan) it was not possible for the dredge to get close enough to the corner for this method to work, and recourse was had to jetting. For this purpose a 2-inch water line fitted with a ½-inch nozzle and water at about 90 pounds pressure was used. A ¾-inch air line was carried down outside the pipe to about 6 inches from the nozzle. The air line was plugged and a number of small holes drilled in it close to its lower end. The air, which was under a pressure of abou 100 pounds, agitated the water so that the tidal currents carried away the material loosened by the jet. By this means the ground elevation in this corner was lowered about 10 feet, and the excavation brought down to grade. A large boulder found in the same corner was disposed of by jetting alongside and causing it to sink into the hole thus formed.

YARD AND SHOPS

The area between the bulkhead wall and the street was filled chiefly with cinders brought in by scow, unloaded over the bulkhead wall by derrick and clam-shell bucket, and distributed by drag-line scraper. The original intention was to make this fill with the material dredged from the basins, but it was found to be unsuitable for handling with an ordinary bucket, so the scheme was abandoned and the fill made as described above. About 40,000 cubic yards of fill was required.

The principal buildings in the filled-in area have pile foundations and the others have spread footings. All have steel frames with brick or corrugated iron walls, and roofs of wood, corrugated iron or reinforced concrete. The carpenter shop is a two-story building, the others are one story.

The machine shop is provided with all the usual machine tools, including lathes, planers, milling and boring machines, and a 20-ton traveling crane. There is a 32-foot lathe on which can be turned the propeller shaft for the largest ship, and it is also equipped with a portable electric welding machine which can be wheeled around to wherever there is work to be done, even on board the ships.

The blacksmith and pipe shop with its extension affords ample room for a large number of forges. The machines installed there include a power hammer, a reverberatory tilting furnace, two pipe machines, bending slabs, brazing hearth and electric spot welder.

The plate and angle shop, which is the largest shop in the plant, is provided with punches, shears, bending slabs, a small bending roll for plates up to 10 feet wide, a mandrel roll and a large roll for plates up to 32 feet in length. There are also two oil-burning heating furnaces, a plate furnace which will take a 35-foot plate and an angle furnace which will take a 50-inch shape. Jib cranes are used for handling the material.

The carpenter shop is provided with a planer, matcher, band saws, rip saws, plane table and wood working lathes. A well-equipped pattern shop is included in the building. The second story is used for a mould loft and for bench work.

GENERAL EQUIPMENT

At the head of each dock there is a 10-ton electrically operated derrick. There is also a 20-ton floating derrick with a long reach for handling heavy machinery on and off the ships.

The shops are supplied with electric light. A high intensity of illumination is given, care being used to prevent glare. The dry docks are equipped with flood lights, which supply the general illumination. Plugs are provided for lights where required on the under parts of the ships.

Electricity is supplied by the local power company at 6,600 volts, 3 phase, 60 cycles, and is stepped down in a centrally located transformer station to voltages suitable for lamps and motors. From this station it is distributed on overhead lines to the various shops, all of which are operated by electric power.

The dry dock pumps and flooding valves are also electrically operated. One man sits at the window of a small brick building on the shore at the end of the dry docks, and by means of a series of push buttons on a small bench board, starts and stops the pump motors and valves in accordance with signals from the dockmaster outside, thus causing the docks to be raised or lowered. Indicators on the board show the position of the flooding valves at all times.

CONTRACTORS' CONSTRUCTION EQUIPMENT

The following plant was used on the job: Two floating pile drivers, one derrick scow equipped

with a 60-foot boom stiff-leg derrick with Lambert boiler and engine; one Vulcan steam hammer; one small scow, used for handling concrete material; one ¾-yard Rex mixer, electric drive; one ½-yard Rex mixer, gasoline drive; one 1-yard Ransome electric drive mixer; one stiff-leg derrick for handling fill with 60-foot boom and 25 h. p. 3-drum Lidgerwood hoist engine; two vertical boilers, 25 h. p.; one horizontal boiler, 40 h. p.; one 400-foot Ingersoll-Rand compressor. About 300 men were employed. About 1,500 cubic yards of concrete was placed, and one million feet of lumber was used.

Mechanical Snow Loading in Chicago

Modified type of wagon loader with crawler traction loads snow 32 hours continuously from pavement to 8-yard trucks, filling them in 2 minutes each

The initial test of the new snow loader manufactured by the Barber-Greene Company, Aurora, Ill., was made on December 26, 1920, under the direction of Thomas H. Byrne, Superintendent of Streets, Chicago, who writes concerning it that "the loader loaded snow at the rate of better than 3 cubic yards per minute, although no provision had been made in the plowing and piling of snow for this machine. Trucks carrying 8 cubic yards were spotted and loaded out in less than 5 minutes. During the period of operations, temperatures ranged from 32 degrees above zero to 5 degrees below zero, but no change was noted in the efficiency of the loader, which apparently handled snow ranging from slush to almost frozen and was operated with equal success on bitulithic, wood block, granite block and cobble stone pavements.

SNOW LOADER MACHINE WITH CAPACITY TO LOAD 8-YARD TRUCK IN LESS THAN 3 MINUTES

"Hereafter on streets where the loader is used the snow will be plowed in a windrow along the curb, as the machine will load to a width of 6 feet from a continuous windrow equally as well as from isolated piles.

"With the present loader we are expecting a labor saving of better than $450 per 8-hour shift on shoveling from piles into trucks.

"Where we have always had difficulty in organizing crews for night work, we are now able, by the use of the snow loader, to remove snow at night, which time is most advantageous to us on account of the congestion of traffic during the day.

"Our past experience has been that approximately six men would load an 8-yard truck in 20 minutes, whereas the snow loader will load the same 8-yard truck in 2½ minutes."

The machine has a general resemblance to the wagon loader type and is provided with an adjustable 2-arm apron plow which scoops up and turns the snow onto a wide inclined endless belt, positively driven by roller chains on each side, that elevates the snow and discharges it at the rear into motor trucks. Side boards 12 inches deep retain the largest lumps on the belt and increase its effective carrying width to 36 inches.

LOADING SNOW AT THE RATE OF ABOUT 3 YARDS PER MINUTE AT NIGHT

The plow can be adjusted, from the operator's seat, to scrape the street surface clean, or elevated to clear any obstruction. The machine crew consists of 1 operator, 1 helper, and 2 laborers whose time is chiefly required at the plow. While the truck is being spotted under the discharge end of the machine the loader advances, drawing from 3 to 6 cubic yards of snow in the plow and on the belt, and discharging it all onto the truck in approximately

2 minutes. This rapid operation made it possible to reduce the twelve trucks previously required for the same work in Chicago to only four trucks, each of which was loaded in an average of 5 minutes.

The machine is mounted on a pair of 58 x 8-inch crawler tractions and has an elevating belt 22 feet long on centers. It is driven by a 4-cylinder Buda truck type gasoline engine with ample reserve for any operating conditions. It travels forward at 40 feet per minute and reverse at 107 per minute. It is 25½ feet long over all, 6 feet wide, weighs 10,000 pounds and discharges 11 feet 10 inches above street level.

The Illinois Experimental Highway

By Prof. Charles Carroll Brown*

Description of the sixty-four sections into which the two miles are divided. Each section differs in some respect from all the others. Concrete, brick and bituminous concrete wearing surfaces are included in nearly equal lengths.

In the previous installment of this article (see PUBLIC WORKS for February 5) a general description was given of the experimental road being built by the Illinois State Highway Department and an explanation of the principles and ideas to be employed in constructing it and making the proposed tests. In this article will be given a more detailed description of the construction of the several sections of the road.

The road is divided into 64 sections, 4,000 feet containing 25 sections of concrete pavement, 3400 feet containing 22 sections of pavement with brick wearing surface, and 3400 feet of asphaltic concrete wearing surface. Of each of the two latter, a part is being laid upon macadam base and a part upon cement concrete base. The materials, thickness and other features of the pavement are varied so that no two sections are alike in all particulars. The accompanying table shows the principal features of construction of each of the sections.

CONCRETE PAVEMENT

Eleven of the 25 sections of concrete pavement have the apparent purpose of comparing the results of construction according to the present specifications, in sections continuous for each day's work, with results using transverse dividing planes spaced 25 feet apart, constructed with horizontal corrugations in a metal dividing surface, forming an interlocking joint which is expected to prevent vertical motion of slabs along the joints between them.

As will be seen from the table, crushed limestone is used in most sections, with gravel in a few others. The mixtures are made 1:2:3½ in all but 3 sections where they are made 1:2½:4½.

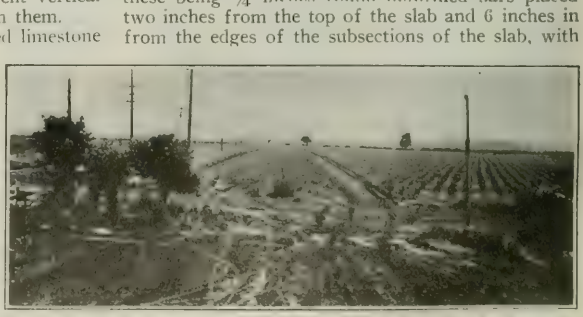
The thickness varies from 9 inches to 4 inches.

Reinforcement of four different types is being used in 10 sections.

In 4 sections calcium chloride or cemite cement have been added. Four per cent of calcium chloride was used in the first 125 feet of section 56, but under the conditions the concrete set so rapidly that it would not be finished properly except by rapid working and the percentage was reduced to 2½ per cent. Cemite cement is a mixture with Portland cement of a chemical having effects similar to those of calcium chloride, the mixture being made by the manufacturers and supplied ready for use. In this case the cement already owned by the state was sent to the mixing plant where the chemical was added and the cement was returned ready for use.

Dividing Planes. Sections 41, 43, and 45-50 have transverse dividing planes which are described as "formed by setting on edge strips of horizontally corrugated galvanized iron, the strips 6 feet long and width one inch less than the thickness of the pavement. The width of the corrugations was 3 inches, the depth one inch, 16 gauge metal, weight of galvanizing 2 ounces per square foot." The metal is set in the concrete with its top edge one inch below the surface of the concrete. In addition to the transverse dividing planes, all but two of the sections have longitudinal dividing planes down the center of the slabs.

Reinforcement. As stated, four methods of reinforcement have been employed, indicated in the table by the letters *A*, *B* and *C*. *A* consists of reinforcing with "circumferential" reinforcing rods, these being ¾ inches round deformed bars placed two inches from the top of the slab and 6 inches in from the edges of the subsections of the slab, with



TEST HIGHWAY, LOOKING WEST FROM THE ROAD THAT CROSSES NEAR TO MID-LENGTH. GRADING NOT YET BEGUN.

*Professor of Municipal, Sanitary and Highway Engineering and Dean of the College of Applied Sciences, Valparaiso University.

a 3-inch lap at intersections. There were thus four rods in each 25 by 9-foot sub-section of the slab, there being eight such sub-sections in the 100-foot length of section 45 and the same number in section 48. *B* refers to reinforcement with circumferential rods in each 25-foot length of the slab, the transverse rods running the full width of the pavement so that this reinforcement is in 25 by 18-foot sections. The transverse rods pass through the longitudinal dividing planes, holes having been punched in the corrugated metal one inch below its upper edge or two inches below the surface of the slab, to pass the bars through. There were no longitudinal rods along the central longitudinal planes of di-

BRICK WEARING SURFACE

Section No.	Length of each section, feet	MACADAM BASE Depth of base, inches	MACADAM BASE No. of courses	CEMENT CONCRETE BASE Mixture	CEMENT CONCRETE BASE Thickness	CEMENT CONCRETE BASE Curb	Thickness of wearing surface	Cushion	Condition January 1, 1921
1	200	4	1	....	....	None	3	Sand	Sub grade only completed
2	100	4	1	....	....	None	3	Sand	" " " "
3	100	4	1	....	....	None	3	Mastic	" " " "
4	100	8	2	....	....	None	3	Sand	" " " "
5	100	8	2	....	....	None	3	Mastic	" " " "
23	200	....	....	1:2:3½	6½	6	3	1 in. sand	Base completed
24	100	....	....	1:2:3½	5½	6	3	1 in. sand	" "
25	100	....	....	1:2:3½	5½	6	3	1 in. sand	" "
26	100	....	....	1:2:3½	4	6	3	Mastic	" "
27	100	....	....	1:2:3½	4½	6	3	1 in. sand	" "
28	200	....	....	1:2:3½	4½	6	3	1 in. sand	" "
29	200	....	....	1:3:5	4½	6	3	1 in. sand	" "
30	100	....	....	1:3:5	3½	6	3	1 in. sand	" "
31	100	....	....	1:3:5	3½	6	3	Sand cement	Base completed, top laid
32	200	....	....	1:3:5	3½	6	3	1 in. sand	Base completed, top laid
33	200	....	....	1:2:3½	2	None	3	.....	Completed
34	200	....	....	1:2:3½	2	None	3	½ in. sand-cement	"
35	200	....	....	1:2:3½	2	None	4	.....	"
36	200	....	....	1:3:5	3	None	3	.....	"
37	200	....	....	1:2:3½	3	None	3	.....	"
38	200	....	....	1:2:3½	3	None	4	.....	"
39	200	....	....	1:3:5	4	None	4	.....	"

ASPHALT CONCRETE WEARING SURFACE

Section No.	Length of each section, feet	MACADAM BASE Depth of base, inches	MACADAM BASE No. of courses	CEMENT CONCRETE BASE Mixture	CEMENT CONCRETE BASE Thickness	CEMENT CONCRETE BASE Curb	Thickness of wearing course	Condition January 1, 1921
6	200	10	2	....	....	..	2 in.	Base not quite finished
7	200	8	2	....	....	..	2 in.	" " " "
8	200	5	1	....	....	..	(1½ in. 1½ in. binder	" " " "
9	200	6	1	....	....	..	2 in.	" " " "
10	200	4	1	....	....	..	2 in.	" " " "
11	200	4	1	....	....	..	2 in.	" " " "
12	200	..	..	1:3:5	4	6	2 in.	Base completed
13	200	..	..	1:3:5	4	6	(1½ in. 1½ in. binder	" "
14	200	..	..	1:2:3½	4	6	2 in.	" "
15	200	..	..	1:2:3½	4	6	(1½ in. 1½ in. binder	" "
16	200	..	..	1:3:5	5	6	2 in.	" "
17	200	..	..	1:2:3½	5	6	2 in.	" "
18	200	..	..	1:2:3½	5	6	(1½ in. 1½ in. binder	" "
19	200	..	..	1:3:5	6	6	2 in.	" "
20	200	..	..	1:2:3½	6	6	2 in.	" "
21	200	..	..	1:2:3½	7	6	2 in.	" "
22	200	..	..	1:2:3½	8	6	(1½ in. 1½ in. binder	" "

[8] Novaculite.

TEST HIGHWAY, LOOKING EAST FROM MID-LENGTH. ROAD PARTLY GRADED. RAILROAD ON THE SOUTH

vision, but only four rods, two near the outside edges and two near the transverse dividing planes of each sub-section.

It will be noted that in sections 45, 46 and 47, where the slabs are 6 inches thick, reinforcement is one inch above the mid-depth of the slab, while in the case of the 5-inch slabs in sections 48, 49 and 50, the reinforcement is ½ inch above the mid-depth of the slab and the lower edge of the reinforcing rods but ⅛ inch above the mid-depth of the slab.

CONCRETE WEARING SURFACE

Section No.	Length of section	Coarse aggregate	Mixture	Thickness, inches	Other materials used	Dividing planes	Type of reinforcement	Condition January 1, 1921
40	200	Crushed limestone	1:2:3½	9	.....	None	None	Completed
41	150	" "	1:2:3½	8	.....	Transverse & longitudinal	None	"
42	150	" "	1:2:3½	8	.....	None	None	"
43	150	" "	1:2:3½	7	.....	Transverse & longitudinal	None	"
44	150	" "	1:2:3½	7	.....	None	None	"
45	100	" "	1:2:3½	6	.....	Transverse & longitudinal	a	"
46	100	" "	1:2:3½	6	.....	" "	b	"
47	100	" "	1:2:3½	6	.....	Transverse	a	"
48	100	" "	1:2:3½	5	.....	Transverse & longitudinal	a	"
49	100	" "	1:2:3½	5	.....	" "	b	"
50	100	" "	1:2:3½	5	.....	Transverse	a	"
51	100	" "	1:2:3½	6	.....	None	c	"
52	200	" "	1:2:3½	6	.....	None	None	"
53	100	" "	1:2:3½	5	.....	None	c	"
54	200	" "	1:2:3½	5	.....	None	None	"
55	200	Gravel	1:2:3½	5	.....	None	None	"
56	200	Crushed limestone	1:2:3½	5	3% calcium chloride	None	None	"
57	200	" "	1:2:3½	5	Cemite cement	None	None	
58	200	" "	1:2:3½	*4	.....	None	None	Rough
59	200	" "	1:2:3½	4	Cemite cement	None	None	graded
60	200	" "	1:2:3½	4	2½% calcium chloride	None	None	and about
61	200	" "	1:2:3½	4	.....	None	None	45 feet
62	200	Gravel	1:2½:3¾	4	.....	None	None	of top
63	200	Crushed limestone	1:2½:4½	4	.....	None	None	laid
64	200	Gravel	1:2½:4½	4	.....	None	None	

* Rolled stone base.

The apparent purpose of extending the reinforcing entirely across the 18-foot width is to hold together the two halves produced by the longitudinal dividing planes. The variations in position of the reinforcing rods should show the value of the rods in reinforcing corners of slabs, whether of sections or of subsections, as combined with the corrugated division sheets; whether the two transverse rods in each sub-section of sections 47 and 50 will be sufficient to prevent longitudinal cracks; whether the longitudinal dividing planes will localize longitudinal cracks; whether the circumferential reinforcing in the 25-foot by 9-foot sub-sections will overcome the tendency toward secondary cracks and breaking and disintegration of cracks, whether of slabs, sub-sections of slabs or intersections of cracks with each other or with edges of slabs or sub-sections.

The letter *C* refers to reinforcement with wire mesh which weighs about 45 pounds per 100 square feet. The total effective longitudinal sectional area per square foot of width is 0.93 sq. in., and the sectional area of the longitudinals per foot of width is 0.087 sq. in.

BRICK PAVEMENTS

These pavements vary in the kind and size of brick used, depth of macadam base and number of courses of macadam, mixture of concrete base and thickness of same, the presence or absence of 6-inch curb, kind of filler, and nature of cushion. In many of the sections lug and lugless brick were laid in alternate 100-foot sections. Sand cushion was used in some cases and mastic cushion in others as indicated. Bituminous filler was used for all sections except 33 to 39, for which cement grout filler was used. Sections 33 to 39 are all of lug brick, 4 or 3 inches thick and all are laid monolithic except section 34 which is semi-monolithic with a ¾-inch cement-sand bed. For the base concrete aggregate, crushed limestone was used. The base varied in thickness from 2 inches to 6½ inches.

ASPHALTIC CONCRETE PAVEMENTS

In the asphaltic sections the wearing surface is Topeka mix, in some sections 2 inches thick, in others 1½ inches thick with a 1½-inch binder. The concrete base is provided throughout with 6-inch integral curbs. The macadam base for the six sections varied from 4 to 10 inches with one 4-inch novaculite base; the 8-inch and 10-inch macadam base being laid in two courses. The cement concrete base was 4 inches thick in four sections, 5 inches in three sections, 6 inches in two sections and 7 inches and 8 inches in one section each. Of the several sections having the same thickness of base, either the proportion of the mixture or the nature of the wearing surface varied in the different sections.

The last column of each table shows the condition of the various sections on January first of this year. It is seen that about two-thirds of the concrete pavement has been completed, about one-third of the brick and none of the asphalt. It is presumably the purpose of the department to finish these as soon as the weather will permit this spring and then to begin the testing of the road by sending over it trucks with loads gradually increased until they exceed the state highway regulations by 50 per cent, careful study of the several sections being made continually by means of the appliances and provisions already described. Mr. Older has promised that not only the construction of the various sections of pavement, but also the methods and results of these observations, will be published at intervals in a bulletin.

Ohio State Road Contracts Held Up

Contracts for $3,000,000 of highways, including 10 miles of the national pike between Columbus and Springfield, the improvement of North High street in Columbus and a Franklin county road contract that has already been attacked in the courts, were awarded by the State Highway Department December 31, the contract signed and surety bonds accepted on January 10, one day before former State Highway Commissioner A. R. Taylor was dismissed by the new governor. The new highway commissioner, Leon C. Herrick, has been instructed to hold up the contracts.

PUBLIC WORKS

Published Weekly
by
Municipal Journal and Engineer, Inc.
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba....$3.00 per year
All other countries .....$4.00 per year

Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

CONTENTS

SOME OBSERVATIONS AND FACTS CONCERNING MOTOR SWEEPERS—By John T. Child 159
Illinois Federal Aid Roads 162
NEW YORK HARBOR DRY DOCK CORPORATION'S PLANT—Illustrated 163
MECHANICAL SNOW LOADING IN CHICAGO—Illustrated 165
THE ILLINOIS EXPERIMENTAL HIGHWAY—Illustrated—By Prof. Charles Carroll Brown..... 166
Ohio State Road Contracts Held Up 168
EDITORIAL NOTES 169
Modifying Construction Methods—A Good Beginning on Housing Extortioners—Winter Transportation
Brindell Convicted 170
Frederick William Shepperd 170
Alfred T. White 170
Obstacles to Construction Operations 171
Economical Plant on Concrete Road Construction..... 171
Ideal Section of Lincoln Highway 171
DRAINAGE IN PORT ARTHUR 172
MILWAUKEE WATER WORKS 173
Salt Lake City's Public Works in 1920 174
Farmers Oppose Good Roads in Kansas 174
Fixed Fee Form of Building Construction Contract... 174
Snow Removal in Boston 174
To Vote on Purchase of San Francisco Water Works 174
HOW CAN A BUILDERS' AND CONTRACTORS' GET-TOGETHER CLUB BE ORGANIZED AND FINANCED? 175
Texas County Road Bonds 176
Specifications for Massachusetts State Highway Work 176
PAVEMENTS LAID DURING 1920—Table..... 176
RECENT LEGAL DECISIONS 178

Modifying Construction Methods

No two large construction jobs, even though as far as possible of the same dimensions, design, type, details and under similar conditions, prove to be exact duplicates when the work is executed, even if they are both done by the same contractors, with the same general equipment, and under the same engineers. No matter how closely it is intended to follow precedents, and to use standard plant and equipment, methods and operations, difficulties, unforeseen conditions or combinations may arise, changes may be required, labor, materials or machinery may be more or less available or accidents may occur that make methods and machinery, ordinarily most efficient, inadequate or unsatisfactory. Comprehensive changes or replacements are likely to be difficult and costly and to delay the operation. The engineers and contractors who in such cases are quick to devise expedients and, grasping the principles involved, can apply scientific and mechanical methods to meet the changed conditions and produce the required results with minimum delay and expense, will be rewarded by a completion of the work more rapidly and economically than would otherwise be the case, sometimes thus securing considerable saving, or avoiding heavy expense.

Such modifications do not generally imply costly or elaborate changes; they are usually simple alterations, rearrangements and adaptations of existing methods and equipment or are produced by using some familiar tool or operation for a new purpose.

The successful solution of these construction problems involves ingenuity, quickness and a thorough knowledge of the subject with experience in handling similar work that makes for good judgment and confidence. The ability to devise and apply such improvements in an emergency is a valuable one that is possessed in large degree by some men and that can be cultivated by most others that are fitted at all for directing construction work. A competent constructor can scarcely visit even the most well-conducted construction work under other management without observing some detail which might be modified or improved to advantage. This talent is cultivated by familiarity with the published methods of constructing work of all kinds that may be available.

Excellent examples of these practical devices are given on page 163 in the description of methods of submerged excavation inaccessible to the dredges and for driving inclined piles without complicated apparatus.

A Good Beginning on Housing Extortioners

The conviction, February 3 in the Supreme Court, New York City, of Robert Brindell for extortion, is a good beginning for the Lockwood Committee now investigating corrupt practices that have so greatly impeded housing and other construction not only in this region but in the principal cities throughout the country.

The testimony so far made public shows incredible depravity and audacity met with surprising non-resistance and a wide-spread collusion limited only by the necessities and resources of the public who have been mercilessly outraged and defrauded on every side.

Brindell and his like have dictated drastic terms and have enforced them by complete financial ruin of those who would not submit to them. Their stealings have been enormous, and up to now they have safely gotten away with them. The robbery has been combined with treachery to their associates and alleged friends and with the influence and im-

munity secured by their huge gains they have exercised great power and become a serious menace to construction, industry, and the general public.

It is to be earnestly hoped that this conviction is only the forerunner of a series that will wipe out the disgraceful conditions and punish to the utmost the criminals invovled throughout the country. Municipal, state and federal authority should unite in most vigorous prosecution of this organized crime and the labor unions especialy should purge themselves absolutely of all the remaining traces of the practices now exposed that discredit every honest man affiliated with the labor interests.

The same should be done unsparingly with all who have dishonestly conspired among the dealers and among any others who have participated in the crimes by collusion with the principals. Incidently it is or should be, astonishing that otherwise reputable lawyers or business men should defend or excese the criminals. No individual or organization open to suspicion of implication in these conspiracies is entitled to confidence until he or it has vigorously and publicly disproved the accusation.

Winter Transportation

For the first time in five years there is a temporary surplus of box cars and freight locomotives which the railroads of the country immediately utilize by moving all the freight possible that ordinarily would wait until next summer, when it would suffer delay from the congestion that it would help to create, which has been the common experience of previous years.

It is computed that $1,394,000,000 is available for highway construction in 1921, and of this amount the Bureau of Public Roads estimates that possibly one-half will be actually expended during the year. Assuming that only $500,000,000 will be spent and that the road work done will cost $50,000 per mile (some of it will cost very much less), there is a minimum of 10,000 miles of highway construction or its equivalent to be done in the next eleven months, which it is conservatively estimated requires the transportation of 100 carloads of equipment and materials per mile, a total of 1,000,000 carloads.

If this is all demanded between May and September, when most of the work is commenced, its transportation will very greatly interfere with other freight traffic and cause delay and loss not only to the road builders but to other shippers. Similar conditions prevail to some extent in all kinds of engineering and heavy construction work, and it is obvious that all of this class of freight that it is possible to receive in advance, should be ordered shipped as quickly as possible so as to take advantage of the present surplus of transportation facilities and prevent later congestion and delay. It is improbable that there will be any reduction in the prices of materials and equipment sufficient to offset the advantages thus gained, and it may even be justifiable in some cases to incur storage and rehandling charges in order to be certain of transportation in advance.

Brindell Convicted

Robert Brindell, the most conspicuous subject of the sensational investigation by the Lockwood Senate Committee on the housing situation, has been convicted of extortion and sentenced to an indeterminate term of from 5 to 10 years' imprisonment at hard labor.

The offense was unusually flagrant and involved the robbery of many tens of thousands of dollars besides enormous damage to important construction operations and discrediting and injuring many innocent parties. It is most regrettable that the maximum penalty of 15 years was not imposed and that the restitution of hundreds of thousands of dollars of extorted money was not accomplished.

It is very significant that although the testimony indicated that Brindell had not been loyal to some of the unions, a mob of hundreds of union men, after his conviction, gave him an enthusiastic greeting and promised him support and release.

Following the Brindell conviction John T. Hetric, lawyer, the originator of the "code of practice" system of collusive bidding, has been put on trial in the Supreme Court.

Frederick William Shepperd

After an illness of two months Frederick William Shepperd, founder and for thirty-three years proprietor of *Fire and Water*, died at his residence, in Brooklyn, on February 8, 1921. As a pioneer in trade journalism and the leader in technical journalism covering fire protection and water supply, he was thoroughly conversant in all lines of water works and fire protection. Mr. Shepperd always stood foremost in progressive movements for the betterment of water works and fire protection. He came out strongly for universal meterage of water for domestic use, and this is but one example of his fearlessness in comnig out boldly for any movement which he saw would ultimtaely benefit the fields he served.

He was an honorary member of the New England Water Works Association, a member of the American Water Works Association and an associate member of the International Association of Fire Engineers.

Alfred T. White

Alfred Treadway White, commissioner of public works of Brooklyn, 1893-94, was drowned while skating January 29. Mr. White was a graduate of the Rensselaer Polytechnic Institute, Troy, and the Brooklyn Polytechnic Institute, and a member of the Brooklyn Engineers' Club. In 1876 he built the first successful tenement houses in this country, for which he received from Harvard University the honorary degree of Master of Arts. He was a member of the Tenement House Commission and of the New York Chamber of Commerce and various clubs and was a prominent philanthropist.

Obstacles to Construction Operations

Editor of PUBLIC WORKS,

Dear Sir: I have read with interest the letters from Mr. Conners, Mr. Newton and Mr. Crane and the editorials in PUBLIC WORKS, January 15 and 22 on "Obstacles to Construction Operations," etc. I think each article was well written and the thoughts worth while, but you and every man must consider the meagre influence by that which is sincere and honest in these times.

I approve of the hammering all the time on that which is good and right, but it seems that it requires lots of hammering to drive a few nails of truth where they will hold. I am not at the age when I wish to say the former times were better than these, but I remember that when I wished to build a home the contractors came to me with plans and specifications and said "we will do this for so much," and then took pride in their work. Is there that pride now? Do men do their work with the desire of producing a thing to be proud of or for the gain they can get?

The present tendency seems to be to cheat, to scheme, and plan to do the least for the most money. This is not in the contractor alone, but it is from the hod carrier to the overseer. The spirit of "beat the game" seems to prevail. The laws are made by lawyers for themselves and their clients and the courts decide that many are unconstitutional if they do not fit the cases. Laws cannot make men honest, or fair, or decent. Where law is a necessity it should be so strict that none would violate it. The man who would put up a dishonest or dangerous building should be punished hard.

Then men are a lot of children—they are willing to let someone do the thinking for them. So we have labor making a fool of itself. An organization that will permit itself to fall into the hands of a few self-asserting and unscrupulous men is not worthy of the honest worker.

They should work together for mutual good, and when they permit themselves to be bullied by a few they cease to be men and become dumb driven animals. The idea that men can use an organization to their own ends is unbelievable. Why should such be the case? Because men are too lazy to think for themselves. If I belong to a union should I not know what it is doing? If there are plans to be considered should I not know them? Why should I let one, two, or three men do the thinking for me?

Then it should be the pride of any organization to teach its members to be loyal to their co-workers and also to their employers. What right has a man to try to beat his employer out of his honest labor? I repeat that we are trying to do things by passing laws when we have so many laws that we cannot live up to them if we wished to. We would be better off if instead of passing laws we let our legislative bodies spend two years studying what laws could be repealed with benefit.

It seems to me that fundamentally back of all the trouble is that patent fact that we are deficient in our educational methods. We devote time to things that are of little value and neglect that which is important. I cannot go into this now, but we can at least teach the young that the greatest thing is to do honest work, put forth effort worthy of praise and that they should give as they would like to receive.

Less law, more honesty, and less of the trying to do the other fellow.

Yours sincere,

P. DAVID SHULTZ, M.D.

Economical Plant on Concrete Road Construction

In constructing a reinforced concrete road near Siegfried, Pa., the Arthur McMullen Co., of New York, made use of an equipment which cut the labor cost per square yard down to $.28 on the record day, when 576 lineal feet of 18-foot road averaging 7⅛ inches thick was laid with a payroll cost of $331.75 for a 9½-hour day, equivalent to 24½ cubic yards per hour.

The contract calls for 28,800 feet of reinforced concrete road 18 feet wide, 8 inches thick at the center and 6 inches at the edges, reinforced with wire mesh weighing 25 pounds to the square yard, placed two inches below the surface. The reinforcing of the concrete, which requires practically placing the concrete in two layers, adds to the time required for constructing the road. The concrete was mixed 1:2:3 with a 1¼-minute mixture.

The superintendent for the contractor, R. P. Johnston, found that it would cost approximately $35,000 to install an adequate industrial railway system, while for $10,000 he could obtain sufficient trucking equipment, including 7 one-ton dump-body trucks, and the latter plan was adopted. Cement was placed at convenient intervals along the roadway and the sand and crushed stone were hauled an average of about a mile by these trucks from the material bins. On reaching the mixer, the trucks were run onto a simply designed turntable which was placed just in front of the loading skip. The truck was then turned by hand by two or three men so as to bring the rear end over the skip, the load was dumped and the truck run off of the turn-table. At each movement of the mixer, which was made about once for each 20 lineal feet of road laid, the turn-table was moved by hooking it to one of the trucks, which dragged it to the desired position. Only a few seconds were required for placing the turn-table in position. Concrete was mixed by a Smith 21-E boom and bucket paving mixer.

Ideal Section of Lincoln Highway

In our issue of May 15, 1920, we referred to the plan to construct at some point on the Lincoln Highway an ideal section of road and the appointment of a committee of experts to prepare plans for such section. It is reported that this committee has decided on most of the points for this ideal section, the following ones having been adopted subject to review at the final meeting of the committee:

The specifications are to be predicated upon an average traffic of 15,000 passenger automobiles per 24-hour day, traveling at a speed of 35 miles an hour, and 5,000 motor trucks traveling at an average speed of 10 miles an hour; with a maximum load of 800 pounds per inch of width of tire actually in contact with the road surface, and 8,000 pounds per wheel. (When traffic exceeds these limits, it is considered desirable to construct another parallel road rather than increase the width or strength of the existing road with a view to concentrating additional travel upon it.)

The right-of-way should be 100 feet wide. Submerged drain tiles and catch basins should be used for drainage instead of side ditches. The pavement selected is concrete, reinforced, 10 inches thick, with earth shoulders. Curves should be as few as possible and none with a shorter radius than 1,000 feet, and should be super-elevated for a speed of 35 miles an hour. There should be a foot path for pedestrians, guard and

warning signs, and guard rails at all embankments. All crossings at grade should be eliminated and all obstructions to vision should be removed at intersecting roads for at least 500 feet each way from the intersection. Comfort stations, park sites and camp sites should be established. All wires should be placed underground. Advertising signs and all signs of direction or distance except those placed or authorized by proper state authorities should be prohibited, and all distance markings should originate at the municipal headquarters of the town or city referred to. The section should be lighted, and adequate, intelligent, continuous and prompt maintenance provided.

All of the decisions were unanimous except that one member dissented from the limit of total travel and one from the limit of load. Practically the only point upon which there was disagreement was that of the cross-section, that is, the number and arrangement of traffic lanes, some recommending a three-traffic lane pavement, 27 feet wide, others four-traffic lanes, separated by a central parkway, and still others separate travel lanes for motor trucks and for passenger cars. Plans and specifications are being drawn up for each of these ideas and this matter will be carefully considered at the next meeting of the committee.

Drainage in Port Arthur

Probably best surface drainage of any south-western city. Both surface and house sewage pumped. Rainfall and run-off data collected.

About a year and half ago the city of Port Arthur, Texas, voted a bond issue of $270,000 for street improvement, of which $35,208 was to be used for surface drainage. Many miles of gutters and main drainage ditches were opened and city engineer Clarence E. Ridley states in his last report that the city probably has the best surface drainage system of any city similarly situated on level ground and without storm sewers.

Drains lead to three pumping stations. The largest of these is equipped with three 48-inch Wood screw pumps, which connect to a 100-horse power Fairbanks-Morse crude oil engine. The pumps are designed to operate against a 5-foot head, against which two of them will lift 40,000 gallons a minute and the third 55,000. The first two will pump against a head of 11 feet and the third will operate efficiently only to a 7-foot head. This station is operated daily to remove the seepage water and maintain the water in the ditches at a low level. During the last fiscal year 2,379 million gallons were pumped at a cost of $2.09 per million gallons. The cost of pumping during the latest fiscal year was about 33 per cent less than the year previous, the decrease being due mainly to the installation of a fuel oil storage tank. Before the fuel oil tank had been built the city paid 12 cents a gallon for fuel oil in barrels, but paid only 5½ cents a gallon for the same grade of oil in tank cars. The tank has a capacity of 13,000 gallons.

One of the other stations is equipped with two one-million gallon per hour Menge centrifugal pumps, each gear-driven by a 75-horse power motor, these pumps being used only in time of rain to quickly drain the business sections of the city. This station operated about 358 hours during the year and pumped about 358 million gallons. The third station contains one Menge centrifugal pump of one million gallons per hour capacity and this also is operated only in time of heavy rain, its purpose being to relieve the central station. There is no special operator for either of these two smaller stations, but one of the men of the department is detailed to operate it when the rain makes it necessary. At the end of the fiscal year there were drainage ditches totaling 23 miles within the city limits. These have to be kept clean and graded. In addition to the small ditches there are canals so large that machine work is needed to economically grade and clean them.

In addition to the ditches and canals, the city contains 4 miles of storm sewers ranging in size from 8 inches to 42 inches.

While rainfall data had been collected with a view to preparing a complete storm sewer design, the matter of percentage of run-off had not been investigated, although it was recognized that the fact that practically all of the water draining to the ditches was pumped, offered an excellent opportunity for making such studies, and it was hoped that this opportunity would be taken full advantage of during the next fiscal year. However, some data had been obtained for the entire city taken as one unit with an area of 2,320 acres. Taking the total run-off for each of the twelve months as the total amount of water pumped during such month, the percent of run-off from the area that was pumped varied from monthly records of 38 per cent in April to a maximum of 104 per cent in March, the average for the year being 68 per cent. It was noted that the percent of run-off varied directly as the intensity of rainfall but not in proportion to the quantity for any one month. The 104 per cent run-off was explained by the fact that a small amount of rainfall followed a rainy period, the seepage for the latter continuing during the period of the former.

The house sewage of the city also requires to be pumped, there being three pumping stations for this purpose. The total amount of house sewers in the city at the end of the fiscal year was 31.29 miles of sizes from 6-inch to 18-inch. On one occasion during the year a 4,000-foot line of 12-inch force main leading from one pumping station to the canal became plugged, but was flushed out by means of city water pressure. One of the stations pumped 114 million gallons during the

year, another station 4 million and the third station 100 million. Although the third pumped nearly as much sewage as the first, it was estimated to serve only 1,878 persons as against 8,322 served by the first, or 4½ times as many gallons per capita. The cost of pumping averaged $6.80 per million gallons at the first station, $17.10 at the second and $22.73 at the third.

The city engineer, in his report, says: "A close inspection of the sanitary sewers convinced us of the fact that more careful supervision must be exercised if the health of the citizens is to be held supreme. The sewers show large deposits of sand and clay. The entrance of this material must have been gained through loose and poorly laid joints or through house connection stubs which were not carefully made. It is not the intention to cast reflection upon anyone nor to place the responsibility, but I feel that it is necessary to state that the sewer extensions laid here during 1917 and 1918 were not first-class by any manner. In fact, the design, as well as the construction, was inferior in many ways. The repair jobs which it has been necessary to make during the last year, one of which cost nearly $1,000, were due entirely to inferior workmanship when the original installations were made.

"With regard to the design, in the majority of places manholes are 1,000 feet or more apart. In cleaning the sewer it is necessary if the obstruction is at all bad, to construct a manhole to enable the men to properly carry on this work. Each month the sewers are getting worse in condition, and the first remedy is to build more manholes to allow the cleaning process to follow economically."

Milwaukee Water Works

The water works of Milwaukee, Wis., was the subject of a report issued by the National Board of Fire Underwriters under date of December 11, 1920, which report is very commendatory of the works and department.

After giving a general description of the several features of the plant, the investigators sum up their findings in a set of conclusions from which the following are quoted:

"The water department is well organized and the officials are well qualified for their duties.

"Plans and records are complete and in convenient form.

"The present supply works are in good condition, and with the two separate intakes provided, there is slight danger of interruption.

"The pumping stations are in good condition; they are not fireproof, but contain little combustible material and the fire hazard is slight. Pumping and boiler capacity is sufficient to allow for proper reserve and the equipment is in good condition and efficiently operated. Steam pipe in both stations is well arranged, being practically in duplicate.

"The reservoir is in good condition; its capacity, equal to about ⅓ day's consumption, is sufficient to equalize supply during temporary large drafts.

"The per capita consumption is moderate, due to the large percentage of meters." (More than 99 per cent of the services are metered.) "The department is using proper measures to reduce the use of water on the unmetered services.

"Pressures are fair and are well maintained at the pumping stations and in the congested value district."

After stating the amounts of water necessary for good fire protection, the report says: "Fire flow tests showed that these quantities are generally available; but they also showed the effect of the lack of connections between small mains, which results in a poor supply to some hydrants.

"Main arteries and secondary feeders are generally adequate and fairly well arranged except in some of the outlying districts. The percentage of 6-inch pipe is too large, a particularly bad feature in this system where, in many localities, small mains are connected to each other only at long intervals.

"The interior condition of the pipes is good. Valves are in good condition. Hydrants are of satisfactory size and are maintained in generally good condition.

"Separate high-pressure fireboat lines form a valuable addition to the protection in the congested value and manufacturing districts along the rivers and canals.

"The construction of the new intake has added very materially to the adequacy and reliability of the system."

The report contains a number of recommendations, such as that the proposed new tunnel and pumping station be constructed as soon as feasible; that the pumping stations be rendered thoroughly fireproof; that a few larger mains of 12-inch to 20-inch diameter be installed; that for the future, 6-inch and 8-inch mains be adopted as a minimum for hydrant supply in residential districts and 8-inch to 12-inch for mercantile and manufacturing districts, the smaller to be used in each case only in sections where the mains form a complete gridiron; that more gate valves be added so as to reduce the length of line that must be cut out in case of accident or repairs; that fire hydrants be provided with gates on the connections to the mains; that, in important mercantile and manufacturing districts, two hydrants be placed at each street intersection and one midway between intersections where the distance exceeds 400 feet; while in other districts there be one at each street intersection and one at an intermediate point where the blocks are over 400 feet long. Only one recommendation, however, is indicated as being very important and urged for early adoption, this being that "Dead ends be eliminated wherever practicable, large mains frequently connected to distributers at intersections, and long unsupported lines of pipe cross-connected, so that not more than one hydrant will be on a 6-inch main between intersecting lines, and not more than two hydrants on an 8-inch main between intersecting lines."

Salt Lake City's Public Works in 1920

Salt Lake City's expenditures for public improvements were greater during 1920 than during any previous year, according to the city engineer, Sylvester Q. Cannon, the expenditure for this year being $1,938,000, as compared with $700,000 for 1919. Of the sum spent, $586,200 was for water supply; $872,400 for paving, $109,200 for curbs and gutters, $44,600 for sidewalks, $88,600 for storm sewers, $56,700 for sanitary sewers, $35,400 for bridges, $21,900 for operation of lighting districts, $3,500 for water mains and $115,500 for maintenance and routine work and miscellaneous improvements. In spite of the increase of work in 1920, the actual expense of conducting the city engineering department was $32,000 less than in 1919.

Farmers Oppose Good Roads in Kansas

Under the present arrangement the government pays one-half of the cost of new roads in Kansas. Under the plans of Governor Allen and the good roads advocates, the government would continue to pay one-quarter the cost and the state would pay one-quarter from the proceeds of motor car licenses. The remainder would be paid by the counties and townships through which the roads run.

For the past nine months the State Highway Commission has refused to permit contracts for hard road surfaces to be let on account of high prices, and does not intend to award these contracts at present, but desires to go on with the preparation of sub-grades ready for surfacing when prices become reasonable.

This program is violently opposed by the farmers' union, which demands that the legislature shall not provide state aid for hard road building for at least two years. A bill to this effect was passed in the House of Representatives by a vote of 65 to 55, but it is believed that there is no prospect of the bill being passed by the Senate.

Fixed Fee Form of Building Construction

In a paper before the New Orleans Convention of the Associated General Contractors of America, F. A. Wells, vice-president Wells Bros. Construction Co., Chicago, says:

"I believe the fixed fee form of contract accomplishes the two most important objectives:

"First. It will attract to the construction industry men of integrity, capability and responsibility. When this has been fully accomplished the second objective will be realized.

"Second, It will produce for owner, architect and engineer the best possible building for the least possible cost in the shortest period of time commensurate with quality; all made possible because the builder shares their interests under the fixed fee form of contract.

"The objective of the Associated General Contractors must be to place general contracting as a whole on the highest possible plane of responsibility. We must not be the three-ball depository of the gains of the 'artful dodger,' but the national banks of integrity and ability to which owners can come with confidence when they need to draw upon our services."

Snow Removal in Boston

The Mayor of Boston has proposed that private citizens, firms and corporations, and especially certain public service corporations, should co-operate with the city to make the highways passable and safe for horses, notwithstanding snow and ice. tI was determined to make a beginning with Atlantic Avenue, a broad business thoroughfare three miles or more in length.

An agreement has been made by representatives of the Master Truckmen's Association, the Boston Elevated Railway Company, and the Union Freight Railroad Company, which operates a nocturnal freight car line on the avenue, for the thorough and prompt removal of snow from this highway during or immediately after any considerable fall of snow.

Flat surface cars will be used for a great part of this work, but the truckmen will use their horses, hitched to sleds made expressly for the removal of snow and loaned to them by the Boston Elevated Railway Company. Five hundred of these sleds are available. The truckmen's part of the avenue will be divided into about thirty districts, and each district will be assigned to a particular master truckman. By these combined efforts it is expected that the avenue will be cleared in eight or ten hours after the heaviest fall of snow, and attention can then be paid to the intersecting highways.

The spreading of ashes and sand on icy streets will follow the same co-operative plan. The ferry service will attend to the streets running from the ferries to Commercial street; the State House will look after the various streets upon which the State House premises abut; school-house janitors will put ashes or sand on the streets in front of the school buildings and yards; churches, hotels, libraries, apartment houses, office buildings, department stores will be called upon to do their share, and, in many cases, the owner or occupants of private houses have agreed to roll out their ash-barrels and distribute the contents where they are needed.

To carry out this project the Mayor has appointed two committees composed partly of city officials and partly of private citizens, the secretary of the Team Owners' Association being made chairman of the committee on snow removal, and the president of the Boston Workhorse Relief Association being appointed chairman of the committee on the spreading of ashes and sand.

To Vote on Purchase of San Francisco Water Works

By a vote of 13 to 2, the San Francisco Board of Supervisors decided on January 18 to hold a special election on Tuesday, March 8, to submit to the electors a proposal to purchase the Spring Valley Water Co. and to authorize a bond issue of $38,000,000 for the purpose.

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems different will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

How Can a Builders' and Contractors' Get-Together Club Be Organized and Financed? II*

Typical form of constitution, serving as a basis for modification to suit conditions.

The constitution should be simply an expression and definition of your aims and the regulations that you think desirable. In default of any other guide it may be helpful to consider a tentative outline like the following, which will afford suggestions for the principal features and enable you to accept, reject or modify them as you please.

Constitution

Article 1—Name, Place and Purpose.

Name—CONTRACTORS' AND BUILDERS' CLUB of Cincinnati.

Location—Committee room 3 of the City Hall, Cincinnati.

Purposes—Social intercourse, exchange of opinions, discussion of the general interests and the promotion and development of general building and contracting operations.

Article 2—Members

Active Members—Shall be contractors who are engaged in some branch of practical construction work in building or contracting operations of an average yearly value of $50,000 or more and must be resident or have a business office within twenty-five miles of the center of the city of Cincinnati.

Associate Members—May be engineers, architects, lawyers, retired builders or contractors, or others engaged in business closely affiliated with the interests of builders or contractors and who are not engaged or interested in any business or occupations or affiliated with any interest or organization likely to rival, oppose, or be inimical to the interests of builders or contractors.

Honorary Members—May be any person eligible to active or associate membership residing at any distance from the club and who are especially distinguished for achievements in construction, who have rendered signal services to the club or whom the club may wish to honor.

General—Members of all classes must be citizens of the United States, of good moral character, of good business standing and twenty-five years or more of age and must have signed the constitution and by-laws and paid the initiation fee.

Article 3—Election of Members

Admission—Candidates for active associate membership must file an application stating age, residence, amount of business, citizenship and must be endorsed by at least three members of the club. After the application has been posted in the club rooms or notice has been served by letter on all of the members of the club for at least thirty days the application shall be voted by sealed ballot enclosed in endorsed envelopes and five per cent negative of the ballots cast shall elect. If rejected a candidate cannot apply again for election within twelve months.

Honorary members shall be proposed by the board of directors and voted on at any regular meeting after notice has been given at the preceding meeting. One negative vote shall defeat any candidate for honorary membership.

Expulsion—Written charges may be preferred against any member and shall be considered by the board of directors. If, then, an investigation, may prove to be sustained the board shall report to the club with recommendation and expulsion can be secured only by the majority of three quarters of all the club members.

Membership shall automatically cease when dues are more than two years in arrears.

Article 4—Fees and Dues

All active members shall pay an initiation fee of $5, which shall include the dues for the first calendar year, and shall afterwards pay yearly dues of $5.

Associate members shall pay an initiation fee of $10 and after twelve months annual dues of $10.

Honorary members shall be exempt from all initiation fees and dues.

Any member can at any time compound his dues and initiation fees by a payment equal to ten years' regular dues.

Article 5—Officers

Officers of the club shall consist of President, Vice-President, Treasurer, Secretary and five Directors.

The officers of the company shall be elected by letter ballot on the last regular meeting of every calendar year and shall hold office until their successors are elected and qualify.

Their duties shall be those generally devolving on such officers in similar organizations.

The Directors shall consist of President, Vice-President, treasurer and Secretary ex-officio, and of five other members with each representing one of the five other principal trades or interests embraced in the membership of the club. At the first election four shall be elected for one year, and four for two years and at the expiration of these terms the Directors shall always be elected for a two-year term.

Article 6—Committees

The President shall appoint standing committees of three or five members each as follows: House committee, membership committee, executive committee, entertainment committee, committee on plans and specifications, committee on methods, operations and practice, committee on improvements, committee on law, committee on plant and equipment.

Article 7—Meetings

Regular meetings shall be held in the club rooms at 8 p. m. every Monday, except holidays.

Special meetings shall be held the first Monday of each month, excepting holidays, for the discussion of important subjects or the presentation of papers.

Ladies' nights, receptions, lectures or special entertainments, shall be held at the discretion of the entertainment committee.

The annual meeting, including a dinner or excursion, or both, shall be held during the month of January as arranged by the executive committee and the committee on entertainment.

Article 8—Amendments

Proposed amendments to the constitution must be signed by at least five active members in good standing, must be mailed to each member of the club at least ten days before the meeting at which it is announced for discussion and

*Part 1. Preliminary operations; preparations for first meeting; arrangement of formalities; adoption of constitution by charter members; payment of initial expenses; financing and optional incorporation, was published February 12.

must be voted on by ballot at least one week after the discussion in regular meeitng. A majority of three-fourths of the votes cast is required to carrv the amendment.

By-Laws

Any additional regulations concerning the character of the papers and addresses, the duties of officers and committees, the activities of the club, the control of its property, and its programs and all routine matters will be provided for in by-laws.

One of the principal features of the by-laws is to fix a regular program of business at regular meetings and at special meetings. The program for regular meetings may consist of (1) roll call, (2) reading and approval of previous meeting, (3) special business, (4) unfinished business, (5) new business, (6) report of committees, (1) election of members, (8) paper, address or discussion of the evening, (9) adjournment.

At the annual meeting there should be an address by the incoming and outgoing presidents, reports of the secretary and treasurer and of all standing committees, election of officers, amendments to constitution, if any, and other important business.

Such an outline as the above is sufficient for a large and prominent organization. Very much less will suffice for a tentative organization which may omit a large part of the details here enumerated. They are, however ,useful in giving a line on the points most frequently developed in organizations of this character and in affording a basis of elimination or changes suited to the local condition.

LECTURES AND ADDRESSES

An impetus may be given to the club that will give it local prestige and aid its early growth by inviting prominent men, distinguished for their success in construction lines, to address it on special occasions when something of an event can be made by engaging a public auditorium, issuing invitations to individuals and local or neighboring societies ,holding a smoker, reception, dinner, etc.

You can thus have after-dinner addresses or descriptions of some special or important works, like, for instance, The Quebec Bridge, The Catskill Water Works, Difficult Foundations, Construction of Concrete Buildings or Bridges, Highways, Skyscrapers, etc., etc.

Consulting engineers, contractors, architects, city officials, college professors and others familiar with construction and industrial subjects are often willing to help in such matters and some of them have very attractive stereopticon slides to illustrate their remarks.

The club will, of course, defray their traveling expenses and entertain them as guests while in town. No other compensation is usually expected for speakers from neighboring cities, but if the speaker comes purposely from a considerable distance he should receive an honorarium of $25 to $100 or, if he is a professional man, it may be arranged to find a client there for his consultation services. If he delivers a lecture, a commission to give other lectures for regular fees for some local city, or church, or society club, or other interest may be arranged for the same trip, and thus compensate him for valuable time with little outlay for your club.

Texas County Road Bonds

During the year 1920 33 counties in Texas issued bonds totaling $7,879,000 for road construction, an average of nearly $240,000 per county. The State Highway Department does not guarantee that there may not have been issues of bonds which are not known of in calculating this total. The largest amount issued by any one county was $1,500,000 by Montgomery Co., the next largest was $1,000,000 by Coryell Co., while the smallest in the list was $20,000 by Hood Co.

Specifications for Massachusetts State Highway Work

The New England Road Building Association recommends that the limit of free haul on both excavation and borrow should be 1,000 feet, the length of haul to be figured from the borrow pit or place of excavation to the place of deposit, and that the price on overhaul should be increased to at least one cent per cubic yard per 100 feet.

Pavements Laid During 1920 *

Quantities are square yards or miles unless otherwise indicated.

Cities and States	Sheet Asphalt	Asphalt Concrete	Tar Concrete	Rock Asphalt: Bitulithic	Rock Asphalt: Bitoslag	Rock Asphalt: Warrenite	Rock Asphalt: Willite	Asphalt Macadam
Michigan								
Ann Arbor	.....	20,000	.....	.....	.....	.....	.....	.....
Detroit	15	.....	.....	.....	.....	.....	.....	.....
Flint	225,000	.....	.....	.....	.....	.....	.....	.....
Howell	.....	21,386	.....	.....	.....	.....	.....	.....
Hudson	.....	14,027	.....	.....	.....	.....	.....	.....
Jackson	135,000	.....	.....	.....	.....	.....	.....	.....
Lansing	50,000	.....	.....	.....	.....	.....	790	.....
Minnesota								
Albert Lea	.....	.....	.....	56,000	.....	.....	.....	.....
Little Falls	.....	.....	.....	29,000	.....	.....	.....	.....
Minneapolis	.....	21,349	.....	.....	.....	.....	.....	.....
St. Paul	78,111	109,308	.....	.....	.....	.....	.....	.....
Mississippi								
Clarksdale	.....	38,000	.....	.....	.....	.....	.....	.....
Missouri								
Batesville	.....	106,000	.....	.....	.....	.....	.....	.....
Sedalia	.....	.....	.....	.....	.....	.....	.....	.....
Montana								
Bozeman	.....	.....	.....	20,000	.....	.....	.....	.....
Great Falls	.....	.....	.....	25,420	.....	.....	.....	.....
Nebraska								
Hastings	64,000	.....	.....	.....	.....	.....	.....	.....
Lincoln	19,517	31,804	.....	.....	.....	.....	.....	.....
Norfolk	.....	40,000	.....	.....	.....	.....	.....	.....
Red Cloud	.....	25,000	.....	.....	.....	.....	.....	.....
Nevada								
Reno	.....	.....	.....	67,120	.....	.....	.....	.....
New Hampshire								
Laconia	.....	.....	1,767.85	.....	.....	.....	.....	14,578
Portsmouth	.....	4¾	.....	.....	.....	.....	.....	.....

*Continued from page 155.

PAVING LAID DURING 1920—(Continued)

Quantities are square yards or miles unless otherwise indicated

Cities and States	Sheet Asphalt	Asphalt Concrete	Tar Concrete	Bitulithic	Bitoslag	Rock Asphalt	Warrenite	Willite	Asphalt Macadam
New Jersey									
Bloomfield	.....	14,000	.....	.....	.....	.....	3,000	.....	.....
Camden	36,840	.....	.....	.....	.....	.....	.....	.....	.....
Elizabeth	.....	30,982.3b	.....	.....	.....	.....	.....	.....	51,936
Garfield	.....	.....	.....	.....	.....	.....	.....	.....	.....
Montclair	.....	.....	.....	.....	.....	.....	6,700	.....	2,000
New Brunswick	66,967	.....	.....	.....	.....	.....	.....	.....	6,151
Passaic	11,750	.....	.....	.....	.....	.....	.....	.....	.....
Paterson	.....	.....	.....	.....	65,000*	.....	.....	.....	.....
Plainfield	.....	.....	7,500	.....	.....	.....	.....	.....	.....
Red Bank	13,818	.....	.....	.....	.....	.....	.....	.....	½
Rutherford	.....	.....	.....	.....	.....	.....	.....	.....	19,600
Somerville	.....	.....	.....	.....	.....	.....	.....	.....	.....
South Orange	.....	.....	.....	.....	2,500	.....	.....	.....	.....
West Orange	1,000	.....	.....	.....	.....	.....	.....	.....	.....
New York									
Binghamton	.....	18,077.54	.....	.....	.....	.....	.....	.....	8,024
Buffalo	167,500	.....	.....	.....	.....	.....	.....	.....	.....
Geneva	.....	.....	.....	10,700	.....	.....	.....	.....	.....
Gloversville	.....	.....	.....	10,130	.....	.....	.....	.....	.....
Kingston	.....	.....	.....	.....	.....	.....	.....	45,000*	.....
Herkimer	.....	.....	.....	500	.....	.....	.....	.....	.....
New York:									
Manhattan	156,551	.....	.....	.....	.....	.....	.....	.....	.....
Brooklyn	132,000	.....	.....	.....	.....	.....	.....	.....	6,340
Bronx	97,404.1	.....	.....	.....	.....	.....	.....	.....	.....
Niagara Falls	.....	7,677.5	.....	.....	.....	.....	.....	.....	.....
N. Tonawanda	.....	.....	.....	10,130	.....	.....	.....	.....	.....
Oneonta	.....	.....	.....	.....	.....	.....	.....	.....	19,000
Rochester	40,950	.....	.....	.....	.....	.....	.....	.....	5,870
Troy	.....	.....	.....	15,000	.....	.....	.....	.....	.....
Watertown	2,693	.....	.....	.....	.....	.....	.....	.....	4,300
Waterford	.....	.....	.....	.....	.....	.....	.....	4,000*	.....
North Carolina									
Asheville	2,680	11,837	.....	.....	.....	.....	.....	.....	.....
Durham	18,713	.....	.....	5,758	.....	.....	.....	.....	.....
Fayetteville	15,000	.....	.....	.....	.....	.....	.....	.....	.....
Greensboro	.....	.....	.....	.....	.....	.....	4.09	.....	.....
Monroe	.....	1¼	.....	.....	.....	.....	.....	.....	.....
Statesville	76,000	6,200	.....	.....	.....	.....	.....	.....	.....
North Dakota									
Fargo	.....	40,426	.....	.....	.....	.....	.....	.....	.....
Ohio									
Akron	24,000	24,100	.....	.....	.....	500	.....	.....	.....
Bellaire	64,363	.....	.....	.....	.....	.....	.....	.....	.....
Cincinnati	.....	.....	.....	.....	30,000*	.....	.....	.....	.....
Columbus	3.8	.....	.....	.....	.....	.....	.....	.....	.....
Findlay	.....	1,547	.....	.....	.....	.....	.....	.....	.....
Fremont	4,193	.....	.....	.....	.....	.....	.....	.....	.....
Lakewood	.....	.....	.....	60,987	.....	.....	.....	.....	.....
Lorain	12,250	.....	.....	.....	.....	.....	.....	.....	.....
Marion	.....	14,000	.....	.....	.....	.....	.....	.....	.....
Xenia	40,000	.....	.....	.....	.....	.....	.....	.....	.....
Oklahoma									
Oklahoma City	87,979.9	22,525.4	.....	.....	.....	.....	.....	.....	.....
Oregon									
Astoria	.....	.....	.....	6,343	.....	.....	.....	.....	.....
Pennsylvania									
Allentown	30,393	.....	.....	.....	.....	.....	.....	.....	.....
Beaver Falls	.....	23,000	.....	.....	.....	.....	.....	.....	.....
Bethlehem	19,833	.....	.....	.....	.....	.....	.....	.....	.....
Bloomsburg	36,629	.....	.....	.....	.....	.....	.....	.....	.....
Chester	.....	2,704	.....	.....	.....	.....	.....	.....	.....
Harrisburg	16,220	.....	.....	.....	.....	.....	.....	.....	.....
Lebanon	.....	.....	.....	10,994	.....	.....	.....	.....	.....
Scranton	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wilkes Barre	10,447.04	.....	.....	.....	.....	.....	.....	.....	.....
York	13,726	.....	.....	.....	.....	.....	.....	.....	.....
Rhode Island									
Bristol	.....	.....	1,800	.....	.....	.....	.....	.....	.....
Woonsocket	.....	.....	.....	.....	.....	.....	.....	.....	49,000
South Carolina									
Dyerburg	12,868	19,251	.....	.....	.....	.....	.....	.....	.....
Tennessee									
Cleveland	33,293	.....	.....	.....	.....	.....	.....	.....	.....
Texas									
Belton	.....	.....	.....	.....	.....	.....	.....	.....	3.6
Cleburne	.....	.....	.....	.....	.....	.....	.....	.....	8,000
Dallas	.....	.....	.....	106,885	.....	41,446	.....	.....	.....
Waxahachie	.....	.....	.....	3.63	.....	.....	.....	.....	.....
Weatherford	.....	.....	.....	.....	.....	.....	.....	45,000	.....
Utah									
Ogden	.....	.....	.....	114,080	.....	.....	.....	.....	.....
Salt Lake City	62,263.4	81,273.2	.....	.....	.....	.....	.....	.....	.....
Vermont									
Springfield	.....	.....	2,728	.....	.....	.....	.....	.....	600
Virginia									
Clifton Forge	.....	.....	.....	.....	.....	.....	.....	2,000	2,000
Norfolk	70,718	.....	.....	.....	.....	.....	.....	.....	.....
Richmond	.....	.....	.....	.....	.....	.....	.....	8,000*	.....
Washington									
Olympia	1,370	.....	.....	.....	.....	.....	.....	.....	.....
Seattle	7,786	19,844	.....	.....	.....	.....	.....	.....	.....
Spokane	.....	.....	12,588	.....	.....	.....	.....	.....	.....
Walla Walla	.....	.....	.....	18,700	.....	.....	.....	.....	.....
West Virginia									
Parkersburg	22,342	.....	.....	.....	.....	.....	.....	.....	.....
Wisconsin									
Beloit	30,000	.....	.....	.....	.....	.....	.....	.....	.....
Eau Claire	.....	800	.....	.....	.....	.....	.....	.....	6
Madison	3.03	.....	.....	.....	.....	.....	.....	.....	.....
Racine	7,698.90	.....	.....	.....	.....	.....	.....	.....	2,843
Waukesha	2,500	.....	.....	.....	.....	.....	.....	.....	.....

*Information furnished by dealers. 37,000 Topeka on stone base, 3,000 on concrete base. b—lineal feet.

Recent Legal Decisions

WATER POLLUTION—PETITION FOR INJUNCTION AGAINST MUNICIPALITY DISMISSED

In a suit by a riparian owner against a municipality to enjoin pollution of a stream, the petition alleged that the city had constructed and put into operation a sewerage system for the disposal of specified foul matters; that the sewage of the city drained into certain septic tanks, from which there were drains emptying into a branch that further down passed through the plaintiff's land, and near her residence; that the waters of the branch became contaminated and emitted foul and poisonous odors and gases that were disagreeable and injurious to health, and rendered the plaintiff's residence uninhabitable; "that said sewerage system was not properly constructed, and if it had been . . . it would not contaminate said stream; . . . said sewage is first emptied into a septic tank and thence into said stream; . . . said sewage comes out of said tank into said stream in a highly impure state. . . . Petitioner does not know how said tank is constructed . . . but if same was constructed for the purpose of purifying the discharge into it, the same fails of its purpose." The Georgia Supreme Court holds, Langbridge v. City of Dalton, 104 S. E. 427, that construing the petition most strongly against the pleader, it shows upon its face that the cause of complaint was alleged improper construction of the sewerage system; and no specific defect in the system being alleged, there was no error in sustaining a demurrer thereto and dismissing the petition.

INJUNCTION FOR OBSTRUCTION OF HIGHWAY BY FENCE

The Iowa Supreme Court holds, Phillips v. Crawford, 179 N. W. 937, that township trustees, having the duty of protecting the traveling public against the dangers of actual obstruction of the township highway, may bring a suit to enjoin an obstruction by an abutting owner who has erected a fence thereon.

CONDEMNATION BY MUNICIPALITY OF LAND IN ANOTHER STATE FOR WATER WORKS

Injunction was sought to prevent the city of Walla Walla, Washington, from making certain betterments and extensions to its existing water works system and issuing bonds therefor. The water supply is obtained from Mill creek, which has its source in Washington, flows across the state line into Oregon and through that state for about four miles, then back into Washington. One of the city's problems was that it would be necessary to acquire additional property rights upon and adjacent to Mill creek in Oregon, by the exercise of the eminent domain of that state, and if the city had not the power to do so the improvements could not be made. The Washington Supreme Court holds, Langdon v. City of Walla Walla, 193 Pac. 1, that in view of Washington Rem. Code, 1915, Sections 7612 and 8005, providing for the acquisition of water works within or without the corporate limits of the city, the power of acquiring and owning such property is not limited to property within the state of Washington, the property being held in the city's proprietary, and not in its governmental capacity; and to allow the acquisition is not an assumption of extraterritorial jurisdiction. The state of Oregon might, of course, withhold from the cities of Washington the right to acquire property in Oregon, just as it may withhold such right from any other foreign corporation. But the Oregon legislature in 1909 passed a law providing that any municipal corporation of any adjacent state might acquire any land or water right in the state, by purchase or condemnation for the purpose of water supply. The acquisition of land for water works purposes in Oregon is held to be a public use which will support the exercise of the right of eminent domain under the Oregon statute, in view of the reciprocal laws of the two states upon the matter, notwithstanding the provision of the Oregon Constitution making public use a judicial rather than a legislative question.

AWNINGS AS ENCROACHMENTS ON SIDEWALKS

The Georgia Supreme Court holds, Bailey v. City of Elberton, 104 S. E. 639, on the authority of prior Georgia decision, that an awning of any kind extending over the sidewalks of a city is an encroachment and is to some extent an obstruction, and one which the city has the power to remove; and that a resolution by the mayor and council of the city providing for the removal of wooden and sheet metal awnings in the business section of the city is prima facie valid. While the governing authorities of the municipality may not needlessly, capriciously, and arbitrarily require the removal of awnings from its streets, whether erected under an express or implied license, the burden is upon a plaintiff seeking injunction of such a resolution to show a needless, capricious or arbitrary exercise of power by the governmental authorities of the municipality.

EXCESS WORK DISTINGUISHED FROM EXTRA WORK IN ROAD CONTRACT

The Circuit Court of Appeals, Fifth Circuit, holds, Holmes County, Miss., v. Burton Construction Co., 267 Fed. 769, that the direction of a verdict for a contractor with a county for road work, for excess work done as extra work, was error, where the contract expressly provided that excess work of the same kind as that specified should not be considered extra work, but be paid for at contract price, while extra work was to be paid for on a different basis. The fact that the engineer in charge of the work may have construed the work as extra work would not be binding on the county. The engineer is not authorized to determine the legal effect of plain and unambiguous terms in such a contract. His authority extends only to the application of his engineering judgment to matters of fact in controversy.

NEWS OF THE SOCIETIES

Feb. 21-23 — MINNESOTA SURVEYORS' AND ENGINEERS' SOCIETY Annual convention. Hotel Commodore, St. Paul.

Feb 23 MID-WESTERN CONFERENCE ON HIGHWAY AND HIGHWAY TRANSPORT EDUCATION At Ann Arbor, Mich.

Feb. 24 NEW YORK SECTION AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies Building, New York City.

Feb. 25-26—CONSTRUCTION DIVISION, U. S. ARMY. Annual reunion of those identified with this division during the war. Morrison Hotel, Chicago, Ill.

Feb. 28 — PHILADELPHIA SECTION MECHANICAL ENGINEERS' Engineers' Club of Philadelphia.

Feb. 28 — CHICAGO SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

March 11—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies Building, New York City.

March 11-12 — NORTHWESTERN ASSOCIATION OF GENERAL CONTRACTORS. St. Paul Hotel, St. Paul, Minn.

March 14 AMERICAN ASSOCIATION OF ENGINEERS. The third annual railroad conference Chicago.

March 18 SCHENECTADY SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

April 16 AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Joint meeting with the Association of Iron and Steel Electrical Engineers. Pittsburgh, Pa.

April 18-23 UNITED STATES GOOD ROADS ASSOCIATION. Greensboro, N. C.

April 27—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention. Houston, Texas.

April 27-29—UNITED STATES CHAMBER OF COMMERCE. 9th annual meeting. Atlantic City, N. J.

May 9-11 — AMERICAN ASSOCIATION OF ENGINEERS. 7th annual convention. Buffalo.

May 9-12 — SOUTH-WEST WATER WORKS ASSOCIATION. Oklahoma City. Headquarters Skirvin Hotel.

May 17-19—NATIONAL FIREMEN'S ASSOCIATION. Twenty-third annual convention Fort Wayne, Ind.

June—CONFERENCE OF MAYORS AND OTHER CITY OFFICIALS, State of N. Y. 12th Annual Conference. Elmira, N. Y.

June 6-10—AMERICAN WATER TER WORKS ASSOCIATION. Annual convention at Cleveland, Ohio. Secretary, J. M. Diven, 153 West 71st St., New York.

June 7-9—NATIONAL FIRE PROTECTION ASSOCIATION. Annual meeting. San Francisco, Cal.

Oct., 1921—IOWA SECTION, AMERICAN WATER WORKS ASSOCIATION. Seventh annual meeting.

BROOKLYN ENGINEERS' CLUB

At the regular meeting of the Brooklyn Engineers' Club, February 10, a paper entitled: "Aeronautical Model Testing," was presented by S. S. Rathburn, formerly a member of the Aeronautic Staff Construction Department of the Washington Navy Yard. The author compared aeronautic, hydraulic and marine problems, discussed wind tunnels and other equipment for model testing and compared the performances of full-sized machines with tests on small models, and applied data obtained to other commercial lines.

At the February 17 meeting, "The Making of White Lead" was illustrated by moving picture films showing the process from the ore to the finished product presented by R. L. Haller, assistant manager of the National Lead Company.

On February 24 there will be a discussion of the Transit Situation in Brooklyn.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA

The second annual conference of the Associated General Contractors of America took place in New Orleans, La., on January 25-27. There were present about 250 contractors from 28 states. The meeting was presided over by President Rogers. The necessity of looking not merely to the year ahead but to look years ahead was emphasized.

The first problem before the meeting was that of quantity survey and payment for estimating. A. P. Greensfelder reported that the co-operation of the American Institute of Architects had been secured, but it was maintained that not all the Association of Architects were backing up this movement, and it was recommended that a system of money accounting by contractors be formulated.

The next important problem was that of contracts. Most contracts, it was claimed, are unfair to the contractor, and the two principal forms of contracts to be considered were discussed. These were the cost-plus-fixed-sum contract, a draft of which has been prepared, and the unit-price contract, on which work is now under way.

The question of labor was also considered. High prices were, of course, opposed, but it was decided not to go on record as taking this stand. Open shop was favored and the attempt to yoke union and non-union labor was discussed. A Department of Public Works for the national government was also heartily encouraged. All this was of great interest in view of the need for millions of houses throughout the United States.

Officers for the ensuing year were elected as follows: President, W. O. Winston; vice-presidents, F. L. Cranford, Arthur Bent, Daniel Breck, W. E. Wood; treasurer, Lee Paschall; directors, N. F. Hoggson, W. A. Starrett, G. O. Muhlfeld, J. R. Wiggins, G. C. Mason, Richard McCarthy, A. E. Wells and Charles Ffolliott; and members of the advisory board, R. B. Porter, T. R. Flagler, Thomas Bentley, A. P. Greensfelder, Edward Haupt and E. F. Mullen.

CAPE BRETON BRANCH, E. I. C.

Engineers in Cape Breton have formed a branch of the Engineering Institute of Canada, making twenty branches of the institute. Meetings will be held once a month and headquarters will be in Sydney, N. S. The following officers have been elected: Chairman, C. M. Odell; secretary-treasurer, K. G. Cameron; executives, T. J. Brown, H. F. Lawrence and D. S. Morrison.

CONNECTICUT SOCIETY OF CIVIL ENGINEERS

[illegible] annual [illegible] Society [illegible] held at New Haven, [illegible] 10. [illegible] Society [illegible] at 10 A. M. [illegible] and [illegible] Business [illegible] Papers [illegible] the [illegible] of [illegible] Department of Public Works, [illegible] Mr. [illegible], Mr. [illegible], on October 31, 1919, and also on the [illegible] "The Superior Law" [illegible] by Mr. W. S. Murray [illegible] December 2, 1920. [illegible] were [illegible] discussed [illegible] the [illegible] istration or certification [illegible] engineers, both as a state and federal matter. A bill is now before the state legislature, introduced by Representative Frederick L. Ford. This bill was read and discussed.

The afternoon session was devoted to transportation, the scheduled speakers being A. G. Guthrie on "The Railroad Transportation of the United States"; R. L. Dean on "Shipping"; H. McL. Harding on "Docks, Quays and Piers," and Charles J. Bennett on "Highway Transportation."

Tuesday evening, after the dinner, Mr. R. S. McElwee spoke on "Port Facilities."

The Wednesday morning session was held at the Mason Laboratory, and the topics discussed included the construction and operation of the swimming pool in one of the Hartford parks by Alexander S. Lynch; "Business Conditions," by Eugene Meyer, Jr.; "The Alaska Railroad," by a representative of the Department of Interior, and moving pictures shown by the Portland Cement Association and the American Air Service Corporation.

BROOKLYN ENGINEERS' CLUB

An informal library talk was held on Thursday, February 3, 1921, on the "Canalization of the St. Lawrence River and the Development of Water Power of St. Lawrence and Niagara Rivers." The talk was given by T. Kennard Thomson, consulting engineer, New York City, and was accompanied by lantern slides.

WEBSTER CITY ENGINEERS' CLUB

The Webster City Engineers' Club, one of the sectional clubs of the Iowa Engineering Society, held its first regular meeting January 29. After the regular program the members entered into an informal discussion of the future activities of the club. The club at present has fifteen members and expects to double its membership in the near future.

HIGHWAY CONTRACTORS OF MASSACHUSETTS

A meeting was held January 13 at the Boston City Club, of all the contractors doing highway work. The purpose of the meeting was the formation of a permanent organization of highway contractors to replace the temporary one already formed.

ARKANSAS ENGINEERING SOCIETY

At the annual meeting of the Arkansas Engineering Society held in Little Rock on January 17, it was voted to apply for a charter as a chapter of the American Association of Engineers.

THE NATIONAL CONGRESS OF BUILDING AND CONSTRUCTION INDUSTRY

In accordance with the decision last September, in Chicago, of the executive board of the Congress, local conferences have been organized in Omaha and in Boston. In New York a small group has begun a series of weekly meetings to discuss conditions in the New York district and the need of a local industry conference. A conference organizing committee of eighteen called a conferenec of representatives from all branches of the industry, held on January 25. This conference resolved that an organizing committee be appointed consisting of two architects, two contractors, two sub-contractors, two labor representatives, two manufacturers, two dealers, two financiers, two investing builders, two representatives of the trade press, and two engineers together with such others as will make the committee representative of every interest and element in the industry in New York City to prepare a program providing for the creation of a permanent conference of the building and construction industry in the New York district.

The organizing committee provided for in the resolution quoted is to be appointed by a nominating committee of six which consists of the following men: Electus D. Litchfield, architect; F. M. Feiker, managing editor McGraw-Hill publications; Ronald Taylor, sub-contractor; John Lowry, Jr., general contractor; Andrew J. Post, steel contractor; and Alexander M. Bing, investing builder.

The executive board urges the importance of calling similar conferences to those already held in Omaha, Boston and New York in the following cities: Chicago, St. Louis, Pittsburgh, Philadelphia, Cleveland, New Orleans. Copies of programs of the local conferences already held and information in regard to the methods adopted in calling them will be furnished on application to the secretary of the National Congress of the Building and Construction Industry, 19 West 44th street,

TEXAS ROAD BUILDERS' ASSOCIATION

At the second annual meeting of the Texas Road Builders' Association held in Austin, January 19 and 20, there was an attendance of 127, the objects of the association were enthusiastically promoted and it was determined to endeavor to provide a paid secretary for the organization.

Among the topics discussed was the labor question involving the employment of convicts on road work which was endorsed by Judge L. G. Mathews and by A. F. Mitchell, the county engineer of Milam county, and opposed by B. D. Panas, of the Granite Gravel & Sand Company.

Major Clark Mandago, chief engineer of the Western Brick Manufacturers' Association, Kansas City, presented a paper on "Types of Brick Pavements." Motion pictures were shown illustrating the Holt caterpillar tractors and portable cranes in action.

Capt. J. D. Fauntleroy, engineer in charge of District 6, Bureau of Public Roads, comprising Texas, Arkansas, Louisiana and Oklahoma, presented slides showing road construction, details of pavement and roads that had failed, together with the reason of failure. He stated that Texas has completed 400 miles of Federal Aid highways and has 1,600 miles under construction, thus exceeding any other state, besides which there are 500 miles of State Aid roads completed without Federal Aid. The recent shortage of Portland cement was explained by H. C. Koch, sales manager of the Portland Cement Company.

The following officers were elected: President, L. G. Mathews, Coleman, county judge of Coleman county; vice-presidents, Julian Montgomery, city engineer of Wichita Falls; W. O. Washington, Brownsville, engineer for Cameron county; D. E. H. Manigault, engineer, Division No. 5, El Paso; W. J Kelly, Trinity, engineer for Trinity county; directors, Fred Rightor, Austin, president Southwest Bitulithic Co.; Hugh L. Small, Fort Worth, county judge of Tarrant county; E. L. Dennis, Jr., sales manager, Texas Trap Rock Co., San Antonio; J. C. Nagle, College Station, Dean A. & M. College.

ASSOCIATION OF GENERAL CONTRACTORS

At the New Orleans convention last month, the Association of General Contractors officially endorsed by formal resolutions a number of subjects important to construction interests, including:

A request to the Federal Reserve Board to allocate sufficient funds to aid construction.

Approval of an open market for all construction materials and opposition to all price fixing combinations; and opposition to any combination of unions or contractors limiting employment to any particular class.

R quest that the Secretary of Commerce secure information relative to construction materials.

Approval of a national budget.

Request to Congress that legislation authorizing partial payments of the railroad claims be passed.

Approval of a National Department of Public Works.

Support of the Lockwood Legislative Committee investigation in New York and recommendation that the governors of every state be urged to consider a similar investigation.

Recommendation that contractors do not make agreements fixing for a long period the prices either of labor or material, and instructions to the executive board to investigate what constitutes a fair and just wage in construction trades.

Recommendation that inquiry be made as to the economy of doing public work by day labor.

The tentative program for the principal activities of the association during 1921 includes:

Standardization of building codes.

Industrial relations (of which thirteen specific subjects are enumerated in the report of the committee on labor).

Formulation of specific procedure for use in time of national emergency affecting general contractors.

Research of the proper principles on which action, legislative or other, should be based on materials, labor, transportation, industrial relations.

Report on quantity survey and payment for estimating.

Formation of a system of money accounting for contractors.

Compensation insurance classification and rates.

Preparation and revision of contract forms for use between contractor and (a) owner, (b) sub-contractor, (c) material man, and (d) equipment man.

Promotion of Department of Public Works.

Calder committee on reconstruction and production.

Lockwood legislative committee.

Immigration restriction.

ENGINEERS' CLUB OF BALTIMORE

The Engineers' Club of Baltimore has reorganized and includes the local branches of the chemical, civil, electrical and mechanical engineers. The following officers were elected: President, Ezra B. Whitmann; first vice-president, Dr. Frank M. Boyles; second vice-president, Edward B. Passano,; and treasurer, W. V. Varney.

PERSONALS

George, Howard H., of the Public Service Railroad Co., of Newark, N. J., has been promoted from assistant engineer to engineer.

Dods, Andrew, general manager of the Ontario Sewer Pipe Co., of Mimico, Ont., has been elected utilities commissioner of that municipality.

Stevenson, W. V., has been re-appointed secretary-treasurer of the Rural Municipality of Woodworth, Man., which position he has held for 24 years.

Washington, Walter, has been appointed city manager of Charlottesville, Va., to succeed Shelton S. Fife.

Lynch, Maurice A., has resigned as district engineer at Smethport, Pa., Pennsylvania State Highway Department.

Adams, Francis, has been appointed city engineer of Brantford, Ont.

Fitch, Squire E., has been appointed division engineer, New York State Commission of Highways, with headquarters at Buffalo, N. Y.

Schuck, Adolph P., has been appointed commissioner of street cleaning of Baltimore, Md., to succeed William A. McCleary.

Andros, Charles, formerly senior assistant engineer of the New York State Highway Department, has accepted a position in the U. S. Patent Office at Washington, D. C.

Treadway, J. S., of Fort Worth, Texas, has been appointed county engineer of Bell county.

Egan, Patrick J., clerk of the water commission of New Britain, Conn., died at his home in that city on January 15.

O'Shaughnessy, Jeremiah, superintendent of the division of water, Columbus, Ohio, died on January 28.

Schreiber, Joseph, former chief engineer of the St. Louis water works, died on January 7, at the age of 63.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

MOTOR TRUCKS AND LOADING MACHINES ON ROAD WORK IN CALIFORNIA

Two 5-ton White motor trucks employed on highway work in San Luis Obispo county, Cal., have each daily made six round trips, averaging 13 miles in length, carrying between 5½ and 6 yards of gravel. Four horses, pulling a wagon and two yards of gravel, made two round trips a day, two teams thus transporting four yards to every 35 hauled and spread by a single motor truck.

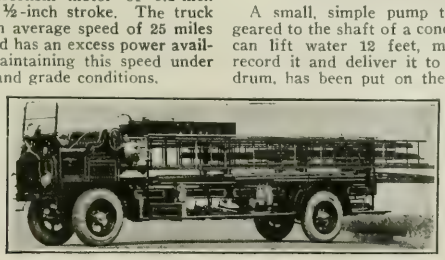
When not engaged in hauling gravel or spreading it along the road, the sturdy trucks are used in pulling road machinery or, equipped with 1,500-gallon tanks, in sprinkling the road.

The present method of excavating, loading, transporting and spreading gravel by motor truck is estimated to cost two-thirds less than in the days when horses were the sole equipment. Now, workmen plow up the tenacious gravel and scrape it within reach of the mechanical loader installed at the side of the gravel bank. A truck can be loaded and started on its way in ten minutes. Arrived at its destination, the truck distributes its load by means of the spreader, which is part of its mechanism.

During five months of 1920, eight miles of gravel were laid in San Luis Obispo county.

NEW FIRE DEPARTMENT TRUCK

A new 216-inch wheel base hook and ladder fire truck, with a forty-gallon chemical tank, has been put into service by the city of Ashland, Wis. This fire-fighting equipment is mounted on a 3-ton four-wheel drive chassis. Power is furnished by an unusually powerful type J Wisconsin motor of 5.1-inch bore and 5½-inch stroke. The truck is run at an average speed of 25 miles per hour and has an excess power available for maintaining this speed under poor road and grade conditions.



HOOK AND LADDER TRUCK WITH CHEMICAL TANK

TRAFFIC TRUCKS AND BODIES

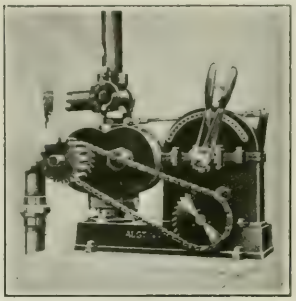
The trucks and bodies manufactured by the Traffic Motor Truck Corporation have been thoroughly standardized for quantity production and the plant and organization efforts have been concentrated on a single truck model.

The truck, with a maximum carrying capacity of 4,000 pounds, has a 133-inch wheel base, is 212½ inches long over all and has a turning radius of 26 feet and a road clearance of 12 inches. The chassis weight is 3,300 pounds and it is equipped with a four-cylinder Red Seal Continental motor, gear-driven oil pump, automatic carburetor, 12-gallon gasoline tank, an oversized radiator, multiple-disc clutch, solid tires, has three speeds forward and one reverse.

The chassis has a 132-inch wheel base, a frame 121 inches long behind driver's seat, and can be supplied with an open seat or with an enclosed driver's cab and can be furnished either with a standard platform and a standard express body, 52½ inches wide by 125½ inches long, a standard 60 x 126 x 24-inch grain body, a standard 61¾ x 127¾ x 42-inch stake body, a standard 57⅛ x 126 x 48-inch hog or cattle body, a standard 56 x 100 x 25-inch all-steel dump body with hoists, or it can be furnished with a standard all-steel 500-gallon oil tank, 127 inches long, having a 42 x 36-inch elliptical cross section, and divided into 100-gallon and 200-gallon and oil can compartments.

AUSTIN METER PUMP

A small, simple pump that can be geared to the shaft of a concrete mixer, can lift water 12 feet, measure and record it and deliver it to the mixing drum, has been put on the market by the Austin Machinery Corporation to govern the amount of water used in mixing concrete. Any required quantity per batch can be secured merely by setting a pin in the device, before the operator opens the two-way valve



SPROCKET DRIVEN METER PUMP

by throwing the starting lever, after which the valve automatically closes as soon as the pump has delivered the predetermined quantity of water to the mixer and requires no farther attention till the lever is again operated for the next batch, and so on. The pump and attachments weigh about 200 pounds and have a range of 250 per cent between minimum and maximum discharge.

THE FORT PITT SECTIONAL BUNK

The sectional bunks made by the Fort Pitt Bedding Company in stock sizes 2 ft. 6 in. x 6 ft. 5 in. and 3 ft. x 6 ft. 5 in., have simple angle-iron riveted frames and steel spring mattresses, and are finished with black japan. They are made in units with a very simple interlock that enables them to be stacked, like bookcases, in sets of two, three or four, without adjustment or possibility of accidental disengagement. They are light, strong, sanitary, comfortable and durable and can be folded flat for shipment.

SANTEST

The Abrams-Harder field test for organic impurities in sand tells whether sand is free from organic impurities and suitable for use in concrete and is useful or prospecting for sand supplies, checking the cleanness of sand received on the job, and for preliminary examination of sands in the laboratory. It eliminates need of scales or weighing chemicals, keeping or transporting of caustic chemical solutions, and the test can be made easily in little time by a non-technical person. The official color chart is furnished so that comparisons can be easily made. Sufficient glassware is supplied to allow the making of six tests simultaneously, and tubes of chemicals sufficient for 24 tests are furnished. The apparatus is neatly boxed for carrying into the field. Sold by the Standard Concrete Apparatus Co.

INDUSTRIAL NOTES

Early in January the Houston Construction Company, Houston, Texas, started work on a 15½ mile contract on State Highway No. 3, Orange and Beaumont road.

Remarkable results are being attained on this work with a 21-E Smith paver, Lee body trucks, a Byers crane connected to a stiff-leg derrick, with a clam-shell bucket, Blaw-Knox road forms and a Lakewood finishing machine.

Fifteen trucks loaded from storage bins filled from railroad cars by a clam-shell bucket are used to keep the paving mixer supplied with the aggregates. The trucks are run onto a turntable just ahead of the paver, where they are turned and then backed up to the paver skip. They then dump their loads directly into the closed end skip.

The working schedule has all been well arranged so that there are only 43 men on the entire job, including those at the material yards, on the trucks and at the paving mixer and finishing machine.

It is a 16-foot road, average thickness 6¼ inches.

The Atlas Powder Company produced a non-freezing explosive that is manufactured in five grades for every blasting requirement; cannot freeze at any temperature; withstands the heat of summer; its stability avoids premature explosions (nothing weaker than a No. 6 blasting cap should be used to detonate it); will not cause headaches to those who use and handle it; is made in all standard size cartridges.

The control of the Chicago Incinerator Company has been acquired by Joseph oder who previously controlled the patent of the B-EE and the Goder furnaces and will move the offices and plant of the company from Turner avenue to East North Water street, Chicago.

REINFORCED vs PLAIN CONCRETE HIGHWAYS

Under this title H. Eltinge Breed, consulting engineer of New York City, and formerly deputy state highway commissioner for New York State, has written an interesting and valuable monograph published by the National Steel Fabric Company, First National Bank building, Pittsburgh, which will mail it on application.

Starting with the importance and rapid growth of concrete highways, which in the last nine years has increased from an annual construction of less than 1,000,000 square yards to 52,000,000 square yards in 1919 Mr. Breed notes that appreciation of reinforcement in concrete pavement that has been manifested by numerous suggestions for its use in an ideal section of the Lincoln Highway. He discusses the destructive cracks in concrete highways, their cause and effect, and the textile and compressive stresses, impact and fatigue of the materials that tend to produce them. He gives his own practice and rules for reinforcing concrete pavement, and computes the economy of cost effected by the use of reinforcement.

He describes a number of pavements which have been reinforced with excellent results and concludes that the use of reinforcement steel in concrete pavements preserves the integrity of the pavement and prolongs its life, and recommends the use of a reinforcement that has a ratio of 1 longitudinally to 3½ to 5 transversely, except in city work where the ratios should be decreased to 1 longitudinally to 1 to 2½ transversely.

The San Francisco Fire Department held a test of smoke masks on January 7. The materials used in the test were sulphur, red pepper, straw, excelsior and wood. Five masks were used in the test, three of the self-contained oxygen type, and two filter masks. One of the filter masks tested was a La France. One filter mask was a complete failure as the operator could only remain in the smoke-filled room for three minutes. The La France mask successfully passed through four tests. A representative of the company, wearing a La France mask, was able to endure the fumes of the burning material during three consecutive tests of 10, 13½ and 15 minutes each. A fireman of the San Francisco department then put on a La France mask and remained in the smoke for 22 minutes before feeling any effects. The self-contained oxygen masks all passed the tests satisfactorily, as was to be expected with their independent air supply, but they did not demonstrate any marked points of superiority over the more comfortable and less expensive filter mask.

The report of the Southern Pine Association for the week ending February 4 shows that the actual production of 135 mills, nine of which were completely shut down and 30 shut down from 1 to 5 days, was 429,082 thousand feet, which is 35.48 per cent below normal.

R. B. Murdock has resigned as executive engineer of the Asphalt Association and is now concerned with the eastern domestic and export sales of the F. D. Cummer & Son Co., of Cleveland and New York, manufacturers of asphalt paving plants and driers. His offices are at 19 W. 44th street, New York City

PERSONALS

Blodgett, L. B., has resigned as assistant county engineer of Gogebic county, Mich., to accept a similar position with Houghton county, Mich.

Hall, N. W. D., has resigned as city manager of Jackson, Mich., to become manager of Tampa, Fla., and is succeeded by Edward C. Meyfarth, assistant city manager.

Little, A. S. B., first assistant engineer of the Public Utilities Commission of Illinois, has resigned.

Lawlor, Thomas F., former president of the Board of Public Works, Poughkeepsie, N. Y., has been appointed superintendent of public works.

Henderson, William S., has been appointed city engineer of Lawrence, Kan., and, when the resignation of L. A. Quigley becomes effective, is to be superintendent of the water plant.

Kelly, W. J., formerly highway engineer, Walker county, Texas, is to be in charge of all road building in Trinity county.

Lyon, Major L. E., Corps of Engineers, U. S. Army, is to be engineer of the Philadelphia district.

DuFresne, L. A., has been appointed highway engineer of Calhoun county, Miss.

Russell, G. A., formerly engineer of Geary county, Kan., has been appointed engineer of Pottawatomie county, Kan.

Wilson, F. S., has been appointed member of the city planning commission of Kansas City, Kan.

Reynolds, Elbert, highway engineer of Jefferson county, Ark., has been appointed engineer for the State Highway Commission. He will continue to direct the highway work of Jefferson county.

Donohue, Jerry, of Sheboygan, Wis., has been appointed city engineer of Hartford, Wis.

Gungel, E. W., has been appointed chief inspector of the smoke inspection bureau of Harrisburg, Pa., which has recently been established.

Koch, H. F., has resigned as city engineer of Denton, Texas.

Irvin, William M., has been appointed county engineer of Jefferson county, Kansas.

Tokelson, F. A., has resigned as county road engineer of Chippewa county, Michigan.

Brusewitz, A. G., has resigned as county highway commissioner of Outagamie county, Wisconsin.

Stahl, C. E., formerly highway engineer of Renville county, Minnesota, has been appointed locating engineer of the Minnesota State Highway Department.

Cappelen, F. W., Minneapolis city engineer, has been appointed by Herbert Hoover as a member of the classification and compensation committee of the American Engineers' Council.

Cutler, Manuel C., has been appointed superintendent of the Bridge and Public Buildings Department of the Department of Public Works, Milwaukee, Wis.

Boaker, J. O., is to become city manager of Tufkin, Texas.

Rosenthal, David, in charge of the Dealers' Service Department of the Southern Pine Association for the past two years, has left to accept a position with the Lane Cotton Mill Company, of New Orleans.

Cadle, C. L., formerly chief engineer of the New York State Railways Association, has been appointed superintendent of Public Works for New York State.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879.

Vol. 50 FLORAL PARK, FEBRUARY 26, 1921 No. 9

Completing Germantown Dam

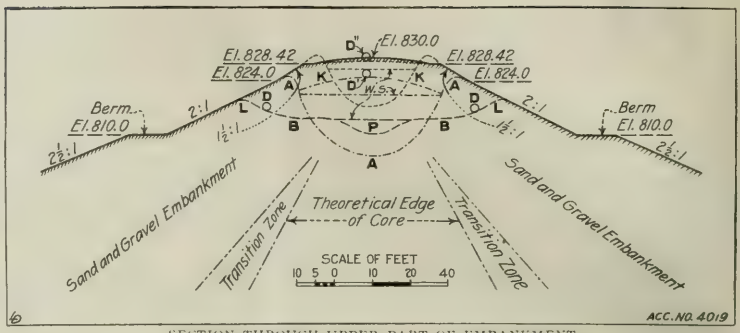
Top of 798,000-yard hydraulic fill 110 feet high placed by special method. Outlet conduits reduced to permanent cross sections. Spillway and paving finished and 20,000 yards of concrete placed in appurtenances.

GERMANTOWN DAM SUMMIT AFTER LAST DEPOSIT OF MATERIALS

This shows the result of the operation depicted on page 185. The dredge pipe is in the center. The ridges of sand and gravel at the edges are excess material to be used in final grading of the dam crest; which will be used as a highway, 25 feet wide.

The Germantown retarding dam is an important unit in the $25,000,000 construction undertaken by the Miami Conservancy District to prevent a recurrence of the disastrous Miami valley flood of 1913 which cost about 400 lives and $100,000,000 worth of property in Dayton, Hamilton and other Ohio towns.

The Germantown dam is built across Twin creek, a tributary of the Miami river, and is the smallest of five retarding dams being constructed by the district. It is 1,210 feet long on the crest, is 110 feet high above the bed of the stream, has a width of 25 feet on top where a roadway is constructed 25 feet above flood level, and has a spillway 10 feet above ordinary flood level. It has side slopes of 3:1, 2½:1 and 2:1, giving it an extreme width of about 700 feet at the bottom. The side slopes are interrupted by three berms. The dam is built entirely of earth embankment extending down into a full-length cut-off trench, excavated on the center line, and has appurtenances that, including the spillway and outlet tunnels, contain about 20,000 yards of concrete. Construction work was commenced by Conservancy forces June 30, 1918, the embankment was completed November 6, 1920, and the



LL are the levees; BB the beaches; P the pool at the stage when the embankment reached an elevation 15 feet below the top. The pool bottom was then scooped out and built into the levees, giving the section AAA. Hydraulic fill was then deposited to the line KK. A repetition of these operations brought the dam to its final elevation.

SECTION THROUGH UPPER PART OF EMBANKMENT

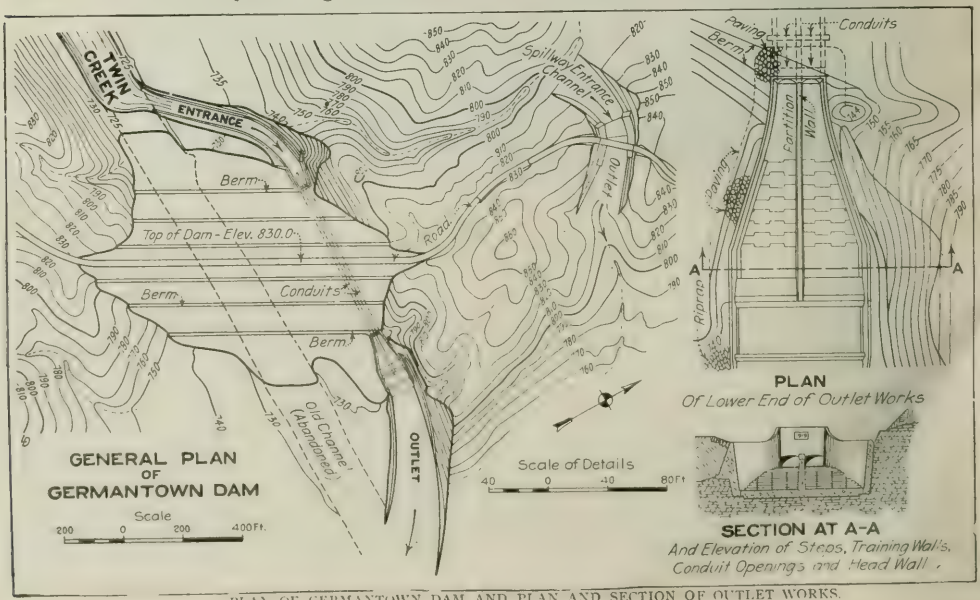
remainder of the work had been practically finished before January 1, 1921.

In a flood like that of 1913 the dam will impound 73,000 acre feet of water covering 2,950 acres and will discharge the water at a maximum rate of 9,340 second feet. The twin outlet conduits are 9 feet 1 inch high and 13 feet wide, and the spillway, located in rock on the hillside at one end of the dam, is 55 feet long on the crest.

PRELIMINARY AND AUXILIARY

Preliminary operations were commenced in April, 1918, by the construction of a camp with 23 cottages, 12 bunk houses, mess hall, store, warehouse, hospital and garage for a population of about 180. There was simultaneously commenced the installation of the construction plant, which included a Lidgerwood electric drag-line excavator with 100-foot boom and 2½-yard bucket, a Marion model 36 caterpillar drag-line excavator with a 40-foot boom and 1½-yard bucket, a Dull gravel washing and screening plant, a 1-yard Smith concrete mixer, standard and narrow-gauge cars, steam and gasoline locomotives, and a transformer sub-station and electric power line from the Dayton Light & Power Co.'s plant.

The excavation of about 105,000 yards of earth for the outlet conduits was commenced June 30, 1918, by the drag-line machine and the last of the 15,368 yards of concrete was placed May 10, 1919, the conduits then having a temporary height nearly twice as great as that of the finished structures, in order to provide ample outlet for possible floods. The concrete for the outlet conduits was made with sand and gravel excavated near the dam by a small Marion drag-line excavator and hauled in dump cars to the gravel washer. The concrete was delivered from the mixer to cars on a narrow-gauge service track terraced into the hillside, and was spouted into position



PLAN OF GERMANTOWN DAM AND PLAN AND SECTION OF OUTLET WORKS.

in the forms through chutes suspended from traveling trestles handling the conduit excavation and also used to handle the concrete forms.

During the construction of the outlet conduits the large drag-line excavator dug channels connecting the inlet and outlet ends of the conduit with the creek above and below the dam, and started work on the construction of the cross dam on the north end of the river, built by the plastic fill method, to retain the hydraulic fill deposited on the lower portion of the north end of the same dam.

The drag-line machine also excavated the cut-off trench for the main dam embankment, in which there was driven a row of interlocking steel sheet piles having a maximum penetration of 35 feet below trench bottom to bearing on solid rock.

The cut-off trench, 30 to 100 feet wide at the bottom, was excavated by the drag-line machine through 7 to 10 feet of loose rock, tripod drills were installed in the bottom of the trench and bored holes from 18 to 28 feet deep, which were loaded with ½ pound per yard of 40 per cent dynamite which, when fired, shattered the material sufficiently to be handled by the drag-line bucket.

SUPPLYING EMBANKMENT MATERIAL

Material for the embankment was excavated, from the bottom of the valley near by, by the Lidgerwood drag-line machine and hauled to the pumping station by 12-yard standard gauge dump cars and steam dinkies. It was dumped alongside a hog box about 20 feet wide and 100 feet long with sheeted sides and a bottom sloping slightly to a drainage opening that covered the sump.

The spoil was washed into the hog box, as required, by two 3-inch 60-pound hydraulic jets, which were carefully operated to maintain the supply as uniformly as possible with the required proportion of water. The grating intercepted the oversize stone, and the small stones, gravel, mud and water passed through it into cylindrical screens in the sump which rejected any material that was too coarse, and passed the remainder through mixing hoppers supplying the suction pipes of two 15-inch electrically operated centrifugal pumps making 505 r. p. m. and handling about 7,000 gallons per minute, carrying from about 6 per cent to 20 per cent of solid material.

When the proportion of the solid matter in suspension is too small, the pumping is, of course, unnecessarily expensive, and when it is too great the discharge pipes soon become plugged, involving considerable delay and expense. Various devices were tried to prevent the plugging, and electric signals were arranged to notify the pump runner instantly of any decrease in the discharge at the end of the pipe, so that measures could be taken immediately to prevent the plugging.

PLACING HYDRAULIC FILL

After the dam site had been cleared and grubbed, a levee with a trapezoidal cross-section about 8 feet high was built by the drag-line machine along the upstream and downstream toes of the embankment, and a discharge pipe, with

TOPPING OUT THE GERMANTOWN DAM

Dragline machine excavating coarse material from the core pool to build up side levees to retain top stratum of "mud concrete."

the outlet supported on trestles about 4 feet above the surface, was carried along the full length of the inner slope of each levee and these were used alternately to avoid the time and expense of shifting a pipe from side to side of the dam as the latter was built up.

An opening in the bottom of the discharge pipe near the end permitted the larger stones to fall on the ground below, forming a conical heap over which the water, flowing in every direction, deposited the smaller stones and earth, soon building up to the bottom of the pipe, after which the end of the pipe was extended, another hole made in the bottom and so on, the materials carried by the water forming a flat slope inclined towards the longitudinal core of the dam with the coarser materials near the outside. The outer edges of the slopes were called beaches and between the beaches on the opposite sides of the dam formed by the two lines of hydraulic pipe there was an intermediate space where the water collected in a deep, narrow pool where the finer material held in suspension gradually settled to the bottom, making a core deposit of fine, soft silt.

After the beaches had been completed from one end of the dam to the other, levees were built by the drag-line machine of the coarse material on the outer edge and the operations were repeated as described in Public Works, May 15, page 419, until the dam had been built up to within about 15 feet of the top.

The slope of the beaches was determined by the size of the material suspended in the water, the coarser it was the steeper the slope. The width of the core was determined by the elevation at which the overflow of the pool was maintained, being greater the higher the elevation, thus enabling the proportion of core and outside materials to be varied at will.

The core was composed entirely of very fine material, averaging about 85 per cent clay and silt and 15 per cent of very fine sand. The core gradually hardened from the bottom up, as was indicated by frequent observations made by sounding with a 6-inch cast iron ball which settled through the soft mud until it stopped in the harder stratum.

The discharge pipes were extended section by section from one end of the dam to the other and then were shortened in reverse manner to the first end by gangs of 6 men handling the 16-foot lengths of pipe and operating the drag-line machine that built the levees in advance of the progress of the pipe.

Increasing Amount of Fine Material

The material hauled from the bottom of the valleys to the hog box in dump cars, being found to be too coarse, was supplemented by finer material washed out of the side of the valley adjacent to and at a higher elevation than the hog box by hydraulic monitors, sluiced down the hillside directly into the sumps, not only increasing the quantity of material transported by a given amount of pumping, but reducing the friction in the pipes so that on this account and for other reasons the rate of pumping increased from 35,000 cubic yards in July to 91,500 yards in October.

Special Method for Topping Dam

When the dam had been built up to the dotted line LBPDL on the diagram, about 15 feet below the finished top, the discharge pipes were located at D, D on the inner slopes of the levees L L, and the width of the core pool having been reduced to about 15 feet, the sand and gravel began to encroach on the transition zones and on the core and the method of construction was modified by the elimination of the transition zones and the building of the remainder of the cross-section of the dam of mixed solid material forming a

When the pool had been nearly filled with earth by the dredge pipe, it was dug out down the center line by the drag-line excavator, creating the deep trench seen in the picture, the excavated materials being used to build up the sides of the trench still higher. This trench is then filled up as after the first stage, the dragline excavator following along just beind the discharge of the dredge pipe, and bringing the new surface to proper level by picking up with its bucket material from the pool, and depositing it where needed.

RESULT OF THIRD STAGE OF TOPPING OUT GERMANTOWN DAM.

homogeneous "mud concrete" rather than the separated strata of coarse, medium and very fine materials in the lower part of the dam. This has the advantage of providing a stiff, hard surface covering the still soft lower strata of the core and able to carry the highway there.

The Marion drag-line machines excavated on the center line of the dam, deepening the core pool and using the dredged material to build up levees on the sides, making the section line AAA. Both of the dredge pipes were removed from the outer faces of the dam and one pipe D′ was installed on the center line, discharging both fine and coarse material in the axis of the dam. Excavating machines working alongside built up new levees K K, the dredge pipe was shifted to the uppermost position D″, and the embankment was finally completed up to the sub-grade of the future highway, making the construction so solid and strong that it showed no signs of settlement under the 40-ton drag-line excavator.

COMPLETION OF OUTLET CONDUITS

After the dam had reached an advanced stage of completion, the extreme end of one of the outlet conduits was closed by vertical planks set against four horizontal 8 x 16-inch cross girders and faced with matched boards with chisel edges at the bottom driven to broom on the floor of the conduit and make a tight joint, excluding the water. The lower end of the conduit was closed by a dam 3½ feet high, made with bags of earth and gravel, and the 700,000 gallons of water between the bulkhead and dam were pumped out in 12 hours by a 6-inch centrifugal pump.

A concrete bulkhead 10 feet thick was then built filling the lower part of the conduit up to the level of the bottom of the floor of the finished conduit and a similar bulkhead 5 feet thick was built at the lower end; the space between these bulkheads was then filled with sand and gravel and on this the new concrete arched floor, 2 feet thick at the center and 4 feet thick at the sides, was laid from end to end of the conduit, thus reducing the depth from the original 22 feet 6⅛ inches to 10 feet 5⅜ inches. After the completion of this conduit the water was diverted to it from the other conduit, the second conduit was closed, and the bulkheads, filling and floor constructed as already described for the first conduit.

The dam was designed and built by the Miami Conservancy Commission, Arthur E. Morgan, chief engineer; Charles H. Hall, assistant chief engineer; E. H. Locher, construction manager; and A. L. Pauls, division engineer. The completion of the dam was described in several articles in the December issue of the "Miami Conservancy Bulletin," from which the accompanying illustrations are reprinted.

Highway Shade Trees in California

In spite of the increased expenses of highway construction, the State Highway Commission of California expects to adhere to the budget whereby $20,000,000 will be spent on roads uncompleted under the first two road bond issues and $20,000,000 for new roads. Preservation of redwoods along the state highway is recommended by the commission, and it has brought about a working agreement between the State Board of Forestry, the department of landscape gardening of the University of California and the Highway Commission whereby a plan for highway beautification will be prepared covering the entire state. The commission also advises convict labor, and says that three more convict camps are to be established and investigations made of the feasibility of establishing state cement plants.

Sewer Assessments in Newton

Increased last year to provide for increase in cost of sewer construction.

In his annual report for the year 1919, Edwin H. Rogers, city engineer of Newton, Mass., called attention to the constantly increasing cost of labor and materials used by the sewer department, as a result of which the city government considered the propriety of raising the sewer assessment rate and Mr. Rogers recommended to the Board of Aldermen that the rate be increased.

A revised ordinance adopted in 1915 had fixed the sewer assessment as a frontage assessment of $.20 per lineal foot and an area assessment of $.01 per square foot within 125 feet of a street or way. Since that time the city had built or ordered built a total of 10.97 miles of sewers at a total cost of $224,513, on which assessments had been or would be levied amounting to $97,316. The average length of sewer built during that five-year period was 2.2 miles, which agrees very closely with the average for the past 20 years, which has been 2.25 miles. The average cost per foot of the sewers built during the past five years has increased from $2.52 in 1915 and 1916 to $5.64 in 1919. The average for the period has been $3.88 per foot and the assessment $1.68 per foot.

Since 1914 the cost of vitrified sewer pipe has increased 75 per cent, brick 83 per cent, cast iron manhole frames and covers 133 per cent, cement 87 per cent and lumber 200 per cent. A general average of the materials was assumed at 100 per cent. In 1914 the city paid unskilled labor 28.1 cents per hour, and during the last quarter of 1919 paid 57.2 cents an hour, an increase of 104 per cent. The cost of a one-horse team without driver has increased from $2.40 per day to $4.

The average cost of the sewerage system of the town up to 1915 was $3.32 a lineal foot, while the cost of future construction was assumed at $7.57 provided present prices were not lowered. "Taking present and past costs into consideration and attempting to discount the future as far as practicable, with the possibility that in the immediate future the cost of doing construction work may increase rather than diminish, it is suggested that for the present the rate of sewer assessment be increased 50 per cent and be fixed at the rate

of 30 cents per lineal foot of frontage and 1½ cents per square foot of area within 125 feet from a street or way in which a sewer is located."

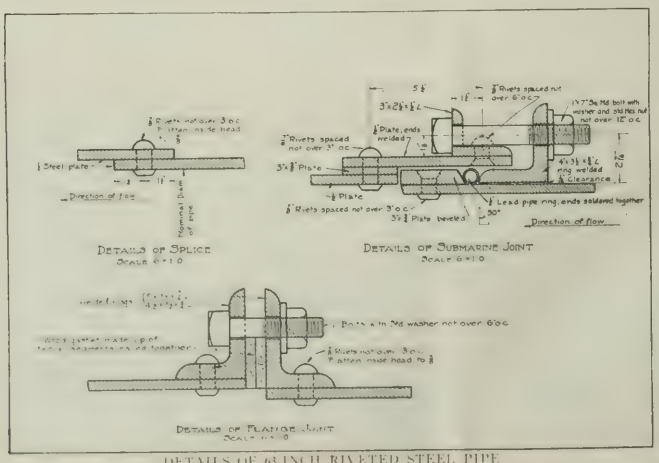
Several months after this recommendation was made, the Board of Aldermen increased the sewer assessment even more than was recommended, establishing the rate at 30 cents per lineal foot of frontage and 2 cents per square foot of area within 125 feet from the street or way in which the sewer is located. On corner lots it is customary to assess frontage on both streets and area on one street to a depth of 125 feet from each street, provided the land is drainable into the sewer. If, in any case, the land is not drainable to a distance of 125 feet, only so much of the land as is drainable is assessed. The drainage line is computed as the contour at which a house connection laid at a 2 per cent rate from the crown of the sewer and at right angles thereto would cut the surface of the land.

Cleveland's Submerged Sewage Outfalls

Cleveland, Ohio, and the district around it discharges about 100,000,000 gallons of sewage a day into Lake Erie, and it is estimated that by 1960 this will amount to 300,000,000. Cleveland's sewage is discharged through three long outlet lines at points less than a mile from large public bathing beaches, while one is approximately four miles from the present water works intakes. The construction of these outfall pipes and the conditions observed about the several submerged outlets were described by George B. Gascoigne and William L. Havens, respectively sanitary engineer and assistant sanitary engineer of the sub-division of Sewage Disposal of Cleveland, in "The Cornell Civil Engineer," which description, slightly abbreviated, is given below:

The first submerged outfall in Cleveland was placed in operation in 1912 at the East 140th street outlet and was designed to discharge at a single point about 2,600 feet off shore and in about 25 feet of water. This outlet pipe, 63 inches in diameter, was made of riveted steel boiler plate, dipped in a preservative coating as a protection against rust and acid. The pipe was delivered by the manufacturer in 50-foot lengths, with a heavy angle-iron flange riveted on each end. At the dock these 50-foot sections were assembled into lengths of 150 feet, which were bulkheaded at the ends and then towed a distance of about eight miles to the location for the pipe line. Openings were then made in the bulkheads and each section of pipe was allowed to fill slowly, gradually settling into its proper place. After the pipe had been lowered, a diver connected the 150-foot sections by means of a special submarine joint. The pipe was laid on an even grade in a trench excavated in the lake bottom and terminates in a single outlet approximately 25 feet beneath the water's surface. This outlet consists of an upturned ell, and is protected by a caisson surrounded by rip-rap.

The second submerged outfall pipe to be constructed in Cleveland was installed at the West 58th street outlet in 1916. The shore end of this pipe consists of 400 lineal feet of 72-inch concrete pipe with cast iron flanges, the pipe being carried on timbers between the piles supporting the storm overflow channel. At the end of this section there is a 72-inch by 60-inch by 60-inch cast iron Y and from one branch of this Y extends a 60-inch line of riveted steel pipe, 2,200 feet in length. The other 60-inch branch of the Y was bulkheaded and provides for the future installation of a similar pipe line. From the end of the 60-inch line there extends 1,000 feet of steel pipe tapering gradually from 60 inches to 24 inches in



DETAILS OF 63 INCH RIVETED STEEL PIPE

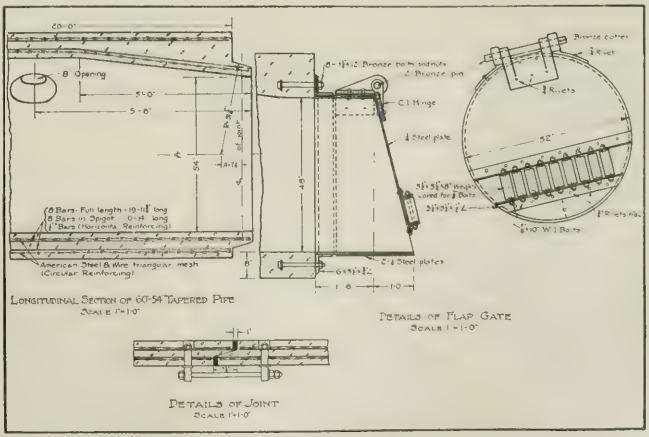
diameter and along this tapered section are openings 6¾ inches in diameter, staggered on 7½-foot centers. This pipe was laid in a trench excavated in the lake bottom and terminates in a cast iron flap gate, so weighted as to insure maximum use of the multiple outlets, under all conditions of flow. The average depth of the openings beneath the water's surface is approximately 30 feet.

The third submerged outlet to be constructed was completed in 1918 and was laid in a trench parallel to and approximately 150 feet distant from the steel pipe installed at the easterly site in 1912. This pipe is 84 inches in diameter and was made of reinforced concrete having a wall thickness of 8 inches. The pipe was cast in 20-foot lengths, each section weighing approximately 25 tons. A concrete bell and spigot, cast to a hemispherical curve, was formed on the ends of each pipe by the use of cast iron forms specially machined. These castings were placed in the bottom of the pipe forms and the concrete of the pipe shell poured upon them. Two holes were left in the concrete about 8 inches from each end of the pipe, into which were later wedged eye-bolts which were bolted together after the pipe was in place. The 20-foot sections were cast on end in steel forms.

After the concrete had hardened sufficiently, the 20-foot sections were turned on side, loaded upon scows and towed a distance of about ten miles to the outlet trench. Each section was lowered in place by means of an A-frame so mounted that it could be swung out over the end of the scow and from which the pipe was suspended in double loops of cable. As soon as the trench had been excavated to grade, the pipe was lowered and the directions for moving it in order to engage with the spigot end of the pipe already in place, were telephoned by a diver to his attendant on the scow. In order to maintain a uniform grade for the pipe line it was often found necessary to support an end of a pipe on concrete blocking or to remove obstructions in the trench by means of a water jet handled by the diver. When the pipe had been brought to correct line and grade, the diver inserted 1¼-inch tie bolts about 4 feet long through the eye bolts on either side of the pipe line and these bolts were tightened by means of a ratchet wrench, hand-operated from a float. Each joint was inspected by the diver and in cases where oakum was used, the joint was caulked from the inside before another pipe was lowered in place.

The total length of this concrete submerged out is 3,200 feet, of which the last one thousand feet consists of a section tapering from 84 inches to 48 inches in diameter. Along this tapered section there are 150 8-inch openings staggered on 6½-foot centers, the axes of the openings being upturned 45 degrees with the horizontal. These portholes were cast in the pipe by means of wooden forms, the concrete being carefully finished to obtain a smooth round orifice. The depth beneath the water's surface of the several points of discharge averages approximately 30 feet. The pipe was laid on an even grade in a trench excavated in the lake bottom and terminates in a 48-inch flap gate so designed as to remain closed except when the flow of sewage exceeds the capacity of the multiple outlets along the tapered section.

The substitution of concrete for steel in the construction of the second submerged outlet at the easterly site was not made as the result of any superior qualities of the materials as such, but was rather a measure of economy and expediency. At the time the second pipe line was proposed (1917) steel in any form was difficult to obtain and consequently the price bid per lineal foot for steel was approximately twice that submitted for the equivalent size of concrete pipe. In regard to the relative merits of the two materials, specific requirements and specific handling and laying facilities would no doubt be the deciding factors in nearly every installation, provided conditions were such that prices were at all comparable. While with ordinary precautions observed in laying either type of pipe, the flanged joint used for steel pipe will probably result in less leakage than the bell and spigot joint used for concrete, it should be emphasized that the importance of this factor would depend upon the use and location of the pipe line. It is safe to assume that the concrete bell and spigot pipe would not ordinarily be suitable for a high pressure line although the actual leakage on this particular pipe amounted to slightly less than one



DETAILS OF REINFORCED CONCRETE PIPE AND SUBMARINE JOINT

cubic foot per minute per joint, when tested under six feet of static head. The difference in durability of the two materials would probably be negligible except in the case of sewage carrying an exceedingly high percentage of acid industrial wastes. Another advantage in the use of concrete lies in the carrying capacities of the two pipes and especially is this true if steel forms are used and care is exercised in the making and pouring of the concrete. It may be said, however, that due to the greater weight of the concrete pipe and to the consequent difficulties in handling and laying the heavier sections, a given length of submerged steel pipe can usually be laid in a shorter time. This is due not only to the extra number of joints which must be made below water, but also to the amount of time required for hauling the sections to the site of the work.

ALLOWABLE LEAKAGE FOR SUBMERGED OUTFALLS

It is to be appreciated that absolute water-tightness in a submerged sewer outfall is not so necessary as in the case of pipe lines used for other purposes such as submerged water supply intakes or land sections of water or sewer pipe lines. However, in order that the general intent of preventing sewage solids from being stranded upon the bathing beaches and of obtaining a continuous pipe line of reasonable tightness may be carried out, it is usually customary to include in the specifications an item which states the maximum allowable leakage. This amount, of course, varies with the material used, the method of laying and the type of joint and is ordinarily expressed in cubic feet per minute per joint when the entire pipe line is tested under a specified static head. The leakage in the 400 feet of 2-inch concrete and 2,200 feet of 60-inch steel pipe installed at the West 58th street outlet, as actually measured under test, amounted to practically one-quarter of a cubic foot per minute per joint when the line was subjected to a 6-foot head. The leakage in the 84-inch concrete pipe installed at the East 140th street outlet amounted, under similar conditions, to approximately one cubic foot per minute per joint. As soon as the construction of the approach channels leading to the outfall pipe were completed and the last section of 84-inch pipe, containing a tight timber bulkhead, was laid, the flow of sewage was utilized to build up the static head on the pipe line. The quantity of sewage entering the approach channels was regulated and measured so that, for any given head, the total leakage was known. In order to cause a leakage of one cubic foot per minute when tested under six feet of head, a single opening of only about one-half inch in diameter would be required. As mentioned above, while this leakage might prove excessive under certain conditions, yet it is believed that this amount, if evenly distributed along the entire length and not confined to a certain few joints of a submerged sewer outfall, will not be objectionable and may be obtained under average working conditions, with either steel or concrete pipe. The experience in Cleveland demonstrates that submarine pipe joints can be made sufficiently tight without the use of cast iron flanges.

TYPE OF OUTLET AT POINT OF DISCHARGE

Since thorough dispersion of the sewage is to be desired in order to obtain the full benefits of the diluting water, considerable study has been given to the most practical manner in which this result could be obtained. From studies of the various Cleveland installations it is evident that the multiple outlet has a decided advantage, especially in relatively shallow depths. The exact location of the single point of discharge of the easterly steel pipe line is easily determined since the disturbance on the water's surface is so marked that when the lake is calm the boiling effect can be seen from shore. In the case of the multiple outlet section, however, it is practically impossible to note any disturbance of the water's surface even from a boat near the outlet. The taper of the pipe is so designed that maximum use is always made of the portholes along the tapered section. Under maximum flow conditions, the flap gate at the end of the tapered section is forced open and then receives its share of the total flow. Assuming that conditions of operation are the same as calculated in the design and that each opening receives its proportion of the total flow, the discharge from each porthole (under an average total flow of 75 m. g. d.) amounts to approximately 0.5 m. g. d. This rate of flow from points some 30 feet below the lake level is not noticeable at the water's surface and such an arrangement must obviously result in more effective dispersion than would be the case if the entire quantity of sewage were discharged at a single point.

CONDITIONS ABOUT SUBMERGED OUTLETS

The first observations of conditions about the outlets were made in 1913 after the 63-inch steel pipe at the easterly site had been in operation about one year. Soundings around this outlet indicated that a carpet of sludge had formed upon the lake bottom to a maximum depth of about two feet and that this deposit was fairly well distributed over an area within a radius of from 100 feet to 300 feet from the point of discharge. After the multiple outlet pipe at the westerly site had been in operation only a few days dredgings were made in this vicinity by dragging a conical iron scoop along the lake bottom, but no evidence of a deposit of sludge was obtained. Six months later, however, masses of sludge varying in size from a few inches to some thirty or forty feet in diameter were seen to rise to the surface of the water in the vicinity of this outlet. These masses disintegrated readily on coming to the surface and either settled again as soon as the gas was liberated or else were scattered in fine particles throughout the lake water. Similar conditions have since been observed about the steel pipe outlet at East 140th street. Dredgings have shown the presence of a carpet of sludge extending as far as one-quarter of a mile from the point of discharge. This condition was particularly noticeable during the excavation of the trench for the concrete pipe which paralleled the former pipe

line and was distant from it about 150 feet. Large masses of sludge were removed by the clam-shell or rose to the surface as adjacent layers were disturbed. The material itself is a black foul mass frequently containing large quantities of long thread-like worms. It has the characteristic odor of decomposing sludge and is usually filled with minute bubbles of gas. It has been observed that most of the gas-lifted sludge may be found after a comparatively long period of warm weather during which time the lake has been very calm. As a rule after heavy storms very little of the material will be noticed in the vicinity of the outlets.

While particles of solid matter from sewage, such as matches, hulls of grain, vegetables, seeds and pieces of soap have been found scattered along the shore of the lake for a distance of perhaps two miles from the easterly outlet, this condition has usually occurred during or just after high sewage flows when the excess storm water has been discharged directly upon the beach. The degree to which this condition will obtain, now that provision has been made to discharge the excess flows 600 feet off shore, is a matter for continued observation. There is no doubt, however, that, under certain conditions, particles from the sewage discharged at the outlets do find their way to the shore. Floating material recognizable as of sewage origin may be noticed in the water about either outlet, the quantity gradually diminishing with increasing distance from the outlet but being readily visible for a distance of from one to two miles. After prevailing westerly or northwesterly winds such particles have been observed at Euclid Beach, a distance of approximately one and one-half miles from the easterly outlet. Seagulls have also been seen taking food from the water as far distant as this point. The same conditions obtain in respect to Edgewater Beach at the westerly site but to a lesser degree on account of the direction of the natural lake currents and of the prevailing winds.

The discoloration of the lake water about the easterly steel outlet can, on a clear day, be easily seen from shore and usually occupies an area about one-half mile in width and from two to three miles in length, gradually diminishing in intensity toward the limits of this area. While the area about the West 58th street multiple outlet appears more turbid than the surrounding lake water, this sewage field cannot ordinarily be noticed from shore. The discoloration probably does no particular harm; nevertheless, it has its sentimental effect upon residents along the lake front in continually reminding them of the presence of sewage in the lake water.

The presence of sleek and oily areas about the outlets is probably visible only from boats in the immediate vicinity and is not noticeable from shore.

Throughout the observations very little notice has been made of odors about the outlets except the stale sewage odor which may be traced quite a distance from the point of discharge, particularly in the direction of the sewage polluted area. Septic odors are noticeable only during warm weather when masses of the sludge are being gas-lifted.

It is believed that the discharge of crude sewage into the lake through any type of outlet will result in the formation of a sludge carpet upon the lake bottom, and that the effect of sewage treatment in reducing the extent of such carpet will depend upon the quantity of sewage solids removed by the treatment processes. Due to the distribution of these solids through a multiple outlet, the thickness of the mat formed should be decreased and hence the tendency of the material to rise to the surface in large masses should be diminished. While smaller masses may be gas-lifted they will be less likely to find their way to shore but will be more easily scattered through the lake water. Under like conditions it is believed that no appreciable difference in the amount of solids stranded upon the bathing beaches will be noticed in the use of the two types of outlet. The multiple outlet should, however, reduce considerably the intensity of the discolored area as well as the odors in the immediate vicinity of the point of discharge.

GENERAL

Robert Hoffman is chief engineer and commissioner of the Division of Engineering and Construction, of which the Sub-division of Sewage Disposal is a part. The work of design and construction herein described was under the supervision of George B. Gascoigne. A. C. Lucas and William L. Havens were the resident engineers in immediate charge of construction and the Great Lakes Dredge & Dock Company and the American Construction Company, both of Cleveland, were the contractors for the westerly and easterly concrete outfalls, respectively.

Building the Du Pont Boulevard

Construction by State Highway Department of 5-mile section of 96-mile, $4,000,000 concrete highway presented by General du Pont. Aggregate from elevated bins at central storage yards, delivered in batch boxes hauled by locomotives on narrow gage service track. Thorough surface finish.

The du Pont boulevard, which traverses the state of Delaware from north to south, forming the backbone of the state highway system of improved roads will, when completed, have cost about $4,000,000 and will be the present to the state by General Coleman du Pont, who, as an individual, commenced its construction several years ago and after the organization of the State Highway Department transferred the work to it in order that it should conform with their standards and methods, although the entire cost is paid by himself.

This section of the road, 5 miles long, is under construction by the Piel Construction Co. of Baltimore, and consists of a standard concrete pavement 16 feet wide, 6 and 8 inches thick, with shoulders 8 feet wide on each side. About two miles of the road follows the alignment of the old highway while the remainder is on an entirely new location eliminating former bends and curves. It passes through a sandy, cultivated country where it will serve as a main thoroughfare for through traffic and for adjacent towns and villages reached by transverse roads, many of which will eventually be improved. The road bed required very little grading; where the location was on old macadam the surface of the old road was loosened by a scarifier and plows and removed to sub-grade, which in all parts was thoroughly cleaned and compacted to receive the concrete pavement.

A steel shod template, operated by 4 men, was used to strike off the sub-grade to the exact depth. This was dragged along the side forms and produced a very uniform, smooth sub-grade for receiving the concrete.

Broken stone imported from Port Deposit was hauled about 3 miles from the railroad track by motor trucks that dumped through a platform trap to the boot of a bucket elevator filling a 20 x 20 x 10-foot elevated storage bin, adjacent to which there was a smaller bin of about half that capacity, with four bottom gates about 8 feet above the service track.

A train consisting of seven steel cars, each carrying two ½-yard wooden boxes, was spotted under the stone bin, the boxes were filled up to the gauge marks and the train hauled by a 24-inch gauge Plymouth gasoline locomotive to the sand storage pile, where sand was shoveled in up to the second gauge marks, and the train proceeded to the cement house of 4,000-bag capacity, where cement was added to each box and the train hauled to the mixer over the tracks laid on the sub-grade of the 8-foot shoulder of the road.

The surface of the concrete pavement was finished by special heavy steel screeds made with a 10-inch channel with a horizontal web and the flanges turned up. The channel was curved to a 2-inch crown and was reinforced the whole length by a 3 x 3-inch angle riveted on the center line of the web. Inclined steel handles were riveted to each end of the screed, which weighed 400 pounds and was operated by two men, producing a very smooth, uniform surface.

The batch boxes were unloaded by a derrick attached to and operated by the Austin cube power loading concrete mixer which swung them over the charging hopper into which their contents were emptied by tripping the side latch that retained the bottom flap of the box.

The concrete surface was compacted by a 6-foot Ransome hand roller and was finally dressed with a 12-inch belt attached to the end of an arched 12 x ¾-inch board that kept it tightly stretched and made it more easily and efficiently handled.

The finished surface was protected from the sun by immediately covering with canvas stretched over 6 x 16-foot frames made of 2 x 4-inch wooden strips. The second day the canvas covers were advanced to protect the fresh concrete and the concrete thus exposed was covered by 2 inches of earth spread over it and kept wet for 14 days. The earth was kept in position for 16 days after the sprinkling ceased.

Water for sprinkling, for the concrete mixing and for other purposes was pumped from the pit where the sand was excavated and washed. The work was commenced in May and finished in November for a contract price of $232,000.

Alarming Deterioration of New York Transportation Lines

Public Service Commissioner Alfred M. Barrett, speaking of local surface traction lines in New York and vicinity says that their present dilapidated conditions due to lack of maintenance funds are such that the cost of putting them in first class condition will very soon approximate the cost of buying entire new equipment on virtually all of the lines operating in Queens County and some in other boroughs.

He says that the aspect is alarming, and that unless there is an improvement soon there will be an increase in the number of accidents and a decrease in service. The estimated amount of the deferred maintenance has increased more than $1,000,000 to the present total of nearly $7,000,000 in eighteen principal companies, five of which are now in the hands of receivers, besides six other companies also in receivership that together operate 700 of the 1,000 miles operated in the city of Greater New York. Ten important lines or systems have ceased operation chiefly because they could not pay expenses.

Farther disorganization is caused by the suits for more than $9,000,000 construction claims that have been brought by thirteen contracting companies, besides which litigation for $1,750,000 damages to buildings and adjacent property is also in progress.

Building Permits and Contracts in 1920

Statistics throughout the United States gathered by the Southern Pine Association show that permits were issued in principal cities during 1920 for all classes of buildings a value of $4,527,245,933, whereas actual construction was undertaken upon permits amounting to only $2,564,582,000. A decrease in the amount of residence construction in comparison with all construction is also shown, only $565,931,000, or 22 per cent, was for residences. This compares with $2,579,800,000 total construction during 1919, which included $849,206,000, or 32 per cent, of residences.

That more money will be available for building is indicated by the action of the real estate committee of the board of directors of the Metropolitan Life Insurance Company, in authorizing loans for 160 buildings, aggregating $2,081,950 and distributed throughout fifteen states. Fifty million dollars is held by the company for this purpose.

PUBLIC WORKS

Published Weekly
by
Municipal Journal and Engineer, Inc.
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba....$3.00 per year
All other countries .....$4.00 per year

Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

CONTENTS

COMPLETING GERMANTOWN DAM—Illustrated 183
Highway Shade Trees in California 187
SEWER ASSESSMENTS IN NEWTON 187
CLEVELAND'S SUBMERGED SEWAGE OUTFALLS—Illustrated 188
BUILDING THE DU PONT BOULEVARD..... 191
Alarming Deteroiration of New York Transportation Lines 192
Building Permits and Contracts in 1920 192
EDITORIAL NOTES 193
Snow Handling Apparatus—Municipal Utilities and Political Boundaries—Important Development of Construction Methods
Municipal Development of Hydro-Electric Power.... 194
Large Increase of Lumber Sales 194
Building Permits and Contracts in 1920 194
1921 Street Work in Topeka 194
Road Traffic Census in Pennsylvania 194
PAVEMENT LAID DURING 1920—Table 195
HOW TO UNJOINT AND HANDLE THREE MILES OF LEAD-JOINT, SMALL-SIZE CAST IRON PIPE? 197
Boston Needs More Water 198
Trade Schools Necessary for the Building Industry.. 198
RECENT LEGAL DECISIONS 199

Snow Handling Apparatus

The storm of February 19 gave New York City a chance to use its million dollars' worth of snow handling apparatus to advantage. The main avenues were cleaned of the fourteen-inch fall in record time, so far as the surface tracks were concerned, there having been very little delay of the street railways.

In removing the snow, however, there seems to have been much less improvement; the loading of trucks and carts by hand has been favored by the warm weather, but is progressing slowly except along the water fronts. Moreover, most of the side streets have not been opened up at all, and the gutters are not cleared for handling a rain or thaw. It is evident that snow loaders or some other contrivances for removing the snow are needed to fully meet the snow problem in cities, where there is no unused space for piling the snow, as there is in country roads. There seems also to be a need for some appliance for cleaning out a narrow channel for gutters, probably traveling on the sidewalks and discharging into the roadway. The trying out and improving of appliances for removal is now the pressing problem.

Municipal Utilities and Political Boundaries

The necessity of disregarding political boundaries where they conflict with physical ones in the developing of municipal utilities such as water supply, sewerage, etc., approaches the critical stage as the population of a district becomes more dense. This is illustrated by the metropolitan district surrounding New York City, which includes a part of New Jersey and Connecticut as well as the southeastern corner of New York state, including Long Island.

At the convention of the American Society of Civil Engineers, New York section, Morris R. Sherrerd, chief engineer of the Department of Streets and Public Improvements of Newark, suggested that a joint commission be created representing New York, New Jersey and Connecticut with power to disregard state lines in the administration of water supplies; while Dr. George A. Soper suggested the formation of a separate state embracing much the same area, for solving the sanitary conditions of this metropolitan district, especially sewage disposal and water supply.

Mr. Sherrerd stated that the district in New Jersey is increasing in population at approximately 4 per cent per year and the water consumption somewhat more rapidly, so that during the past 20 years the water consumption of the city of Newark has doubled notwithstanding the fact that 98 per cent of the services of the city are metered. He believed that the formation of such a commission as was suggested is inevitable when it is considered that there now exists or will exist in the near future the necessity of reciprocity in such matters among these states, and also between New Jersey and Pennsylvania along their mutual boundary.

Important Development of Construction Methods

The substantial completion of one of the five flood protection dams, built by the Miami Conservancy Commission in the Miami valley, not only signalizes the creation of an important safeguard against serious dangers, but it also notably illustrates the successful application of the hydraulic transportation principle to the efficient and economical construction of great earth dams, the elimination of a large amount of hand labor, and the substitution of large units of simple and powerful construction apparatus for a more varied, extensive and costly installation of different types of plant that are likely to be operated with less co-ordination and greater expense and liability to accident and interruption.

The able analysis and co-ordination of princi-

ples, conditions and requirements has defined the practical limits and indicated the character of the general operations, and the details of construction have been so intelligently adapted that remarkable efficiency, rapidity and economy have been attained in a little-known type of important construction, and valuable precedents have been established.

Municipal Development of Hydro-Electric Power

The officers and advisory committee of the New York State Conference of Mayors and Other City Officials have presented to the governor and legislature of New York State a legislative program covering a considerable number of features, among these being one dealing with the securing of hydraulic power rights for the municipalities of the state. The federal hydro-electric power bill recently enacted gives preference to states and municipalities in the application for preliminary permits for boundary waters and for federal waters for the generation of hydro-electric power for municipilaties. The city council of Buffalo some time ago directed the corporation council to apply for such permit in connection with Niagara river. Other cities so situated as to be able to take advantage of this preference are urged to do so and the legislature is requested to enact such legislation as may be necessary to empower and aid the cities in obtaining these water rights.

Large Increase of Lumber Sales

A large increase in the demand for lumber is shown by the Trade Barometer of the Southern Pine Association. During the week ending January 14, 136 mills reported orders received totaling 3,163 cars, or 68 million feet. This is the largest amount of business received in any week during the past nine months. the previous higher mark being in April, 1920.

Production of Southern pine is still reaching new low levels. Last week's output was the lowest of any similar week during the past six years and was 48 per cent below normal. Orders received during the week were 40 per cent more than the actual production. Of 78 mills reporting operating time, 22 operated full time, 20 were closed down entirely, and the others operated on various degrees of reduced time.

Ohio's New Highway Commissioner

Governor Davis has appointed Leon C. Herrick as state highway commissioner, succeeding A. R. Taylor. It is reported that Mr. Herrick is to reorganize the state highway department in conformity with recommendations to be made by Gen. George W. Goethals, who recently surveyed the department here at the request of Gov. Davis.

Mr. Herrick is a member of the Ohio Engineering Society and has had eighteen years' experience in engineering, including two years as assistant city engineer of Mansfield, city engineer of Norwalk and thirteen years in the office of the surveyor of Huron county.

Street Paving in Chicago

The Department of Public Works and members of the Council of Chicago have practically decided upon a repaving program covering 50 miles of streets on which there will be spent in 1921 approximately $5,000,000. The first step has been taken in advertising for bids for 7 miles of highways estimated to cost about $700,000. Council has appropriated $1,000,000 in the annual budget for the repaving work, with the idea that this would be replaced by a part of the $5,000,000 which it is expected to raise by short-term repaving loan, when this shall have been approved by the legislature.

1921 Street Work in Topeka

Topeka, Kan., plans to spend about $500,000 for street improvements in 1921—the largest sum expended by the city in six years. Of this amount more than $300,000 is to be spent for paving and about $200,000 for sewers, bridges and other street work. Petitions are being circulated for paving about 100 blocks and it is hoped to pave 70 or 80 of these during the year. W. E. Baldry, city engineer, has been engaged for several weeks in preparing plans for a $25,000 concrete bridge for carrying street cars as well as other highway traffic.

Street Commissioner W. S. Hancock reports that the equipment is on hand for beginning this work as soon as the weather is favorable. During the past year he has purchased an asphalt plant and two trucks and has on hand $6,000 worth of asphalt and several carloads of stone and fine aggregate.

Road Traffic Census in Pennsylvania

The state highway department of Pennsylvania during 1920 took a census of road traffic on a number of highways of the state and has just made public the figures obtained.

Figures were obtained in a two weeks' census on the Lincoln highway between Philadelphia and Trenton which indicated that a total of 773,604 tons traveled over the highway last year, giving a ton mileage of 10,830,456. It is estimated that this would have required 275 freight trains of 40-ton steel hopper cars. Commercial vehicles comprised 56 per cent of the traffic on this road.

On the Lincoln highway, 56 per cent of the tonnage is carried by trucks, of which 45 per cent were 5-ton, 16 per cent 1-ton, with the balance nearly evenly divided between 2, 3 and 4-ton trucks. The large-truck tonnage is due chiefly to the number of 5-ton trucks traveling on through freight routes as part of a regular long-distance freight service.

On route 34, between Harrisburg and Carlisle, which is water-bound macadam, 63 per cent of the traffic was passenger vehicles on a ton mileage basis, or 81 per cent by number of vehicles. Of the trucks passing over this route, about 28 per cent were 1-ton, about 24 per cent 2-ton, about 18 per cent 3-ton, about 15 per cent 4-ton and about 13 per cent 5-ton. By tonnage, however,

the 5-ton trucks led, with the tonnage decreasing in regular order through the 4, 3 and 2-ton to the 1-ton trucks, which carried about 11 per cent of the tonnage.

A road leading north from Altoona used extensively for hauling coal shows 86 per cent of the ton mileage carried by trucks, the greatest number of trucks and also the greatest tonnage being of 3-ton trucks, with 4-ton trucks making a close second. Over this route, only about 3 per cent of the trucks were 1-ton while about 13 per cent were 6-ton trucks.

It was found that truck traffic was a minimum between 11 p. m. and 1 a. m. and a maximum between 7 and 8 a. m. and 4 and 5 p.m.; also that the heaviest passenger car traffic was between 4 and 7 p. m., although considerable numbers were counted between 10 a. m. and 3 p. m.

PAVEMENT LAID DURING 1920

(Quantities are square yards or miles unless otherwise indicated)

Cities and States	Tar Macadam	Amiesite	Granite or other Stone Block	Brick or Clay Block	Creosoted Wood Block	Concrete	Concrete not Reinforced	Plain (water-bound) Macadam	Gravel	Cement Sidewalks
Alabama:										
Andalusia							15,000			
Montgomery							48,375		77,440	
Arizona:										
Bisbee							5,000			58,5143
Arkansas:										
Ft. Smith										1
Little Rock								3		2½
California:										
Bakersfield							2,635			28,315
Calexico										1
Napa							12,580			1,800
Palo Alto										1,500
San Francisco				12,850			11,160			10,596
Santa Monica							4,716			2,385
Colorado:										
Denver							91,711			
Connecticut:										
Bristol							2,600			26,000 S
Hartford			1,000					38,800		5
Manchester								9,000		3
New Haven							30,033 S	7,500		42,890 S
Putnam							2,000			
Delaware:										
Lewes							900			4,000 S
District of Columbia:										
Washington							53,884	43,148		34,027
Florida:										
Jacksonville				77,320						
Orlando				67,800						
Sanford										15,000 S
Georgia:										
Albany				12,000						
East Point										3
Idaho:										
Boise									2	52
Idaho Falls										13
Nampa										20,000 S
Rupert										37,000 S
Illinois:										
Centralia						17,316				
Champaign						5,846				4**
Chicago			720	40,728	5,072		3,455			
Danville				1,644						2
Galesburg				5,896						
Geneva				6,000		13,000				
Joliet				17,700						40,000 S
Kankakee				2,500						
Marion	7,900			14,000			13,500		3,500	112,000 S
Murphysboro				23,000						61,000 S
Ottawa						2,000				
Spring Valley									2	1
Streator										51,000 S
Taylorville										60,000 S
Waukegan										1,700 S
Wauconda							1,200			1,000 S
Indiana:										
Covington										550 S
Crown Point	100							1,000		500 S
Ellwood							16,784			330
Elkhart				2,450						
Fort Wayne							1,348			23,171
Gary	22,776.8					39,797.54	9,116.79			4,500
Greenfield									6	
Huntington										11,000 S
Jennings								1.06	2.65	
La Porte				5,101						
Lafayette				33,317		7,289	1,714		10,300	5,626 S
Peru							45			
South Bend							1,270			95,192 S
Terre Haute				4,433			3,092		1	1.6
Iowa:										
Adair				21,750			700			
Boone									2	3
Cedar Falls				7,645						
Cedar Rapids				6,817.69			9,994.49			
Charles City										10,000 S
Cherokee							3,382			
Correctionville							30,000			
Davenport	10,239									
Emmetsburg										14,900 S

PAVEMENT LAID DURING 1930 (Continued)

Cities and States	Tar Macadam	Amiesite	Granite or other Stone Block	Brick or Clay Block	Creosoted Wood Block	Concrete Reinforced	Concrete not Reinforced	Plain (water-bound) Macadam	Gravel	Cement Sidewalks
Iowa (Continued)										
Fort Dodge	.....	.....	.....	.....	.....	.....	667	.....	.....	31,000§
Garner	.....	.....	.....	.....	.....	50,000	.....	.....	.....	.....
Mason City	.....	.....	.....	.....	.....	25,000	.....	.....	.....	.....
Muscatine	.....	.....	.....	.....	.....	.....	10,362.51	.....	.....	.....
Tabor	.....	.....	.....	22,000	.....	.....	200	.....	.....	.....
Villisca	.....	.....	.....	3,140	.....	.....	1,570	.....	.....	.....
Kansas:										
Dodge City	.....	.....	.....	52,500	.....	.....	.....	.....	.....	.....
Fort Scott	.....	.....	.....	1,000	.....	.....	.....	.....	.....	.....
Hutchinson	.....	.....	.....	90,000	.....	.....	.....	.....	.....	.....
Independence	.....	.....	.....	3	.....	.....	.....	.....	.....	.....
Manhattan	.....	.....	.....	.....	.....	.....	2,872	.....	.....	1
Osawatomie	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Ottawa	.....	.....	.....	¼	.....	.....	54,598	.....	.....	½
Wichita	.....	.....	.....	110,810	.....	.....	1a	1,503§§	.....	1
Winfield	.....	.....	.....	5½	.....	.....	.....	.....	.....	.....
Kentucky:										
Ashland	2,000	.....	.....	433	.....	.....	.....	.....	.....	.....
Maysville	.....	.....	.....	.....	.....	.....	.....	.....	.....	3,000§
Newport	.....	.....	1,200	.....	.....	3,500	.....	15,000	.....	.....
Louisiana:										
Crowley	.....	.....	.....	.....	.....	.....	.....	.....	10	28,000§
Minden	.....	.....	.....	6,000	.....	.....	.....	.....	.....	.....
Maine:										
Bangor	.....	.....	2,000	.....	.....	.....	5,000	.....	.....	200
Gardiner	.....	.....	.....	.....	.....	.....	.....	.....	¾	.....
Norway	.....	.....	.....	.....	.....	.....	1	.....	.....	.....
Portland	.....	.....	3,196.91	1,252.22	.....	.....	.....	.....	.....	2,224.41
Paris	.....	.....	.....	.....	.....	.....	1	.....	.....	.....
Rockland	.....	.....	526	.....	.....	.....	.....	.....	.....	23
Westbrook	.....	.....	.....	475	.....	.....	.....	.....	.....	.....
Maryland:										
Hagerstown	.....	.....	3,000	.....	.....	.....	.....	.....	.....	3,000
Massachusetts:										
Arlington	4,452.2	.....	.....	.....	.....	.....	4,678.7	.....	.....	9,844.5§
Andover	1¼	.....	.....	.....	.....	.....	.....	.....	.....	.....
Athol	.....	.....	.....	.....	.....	.....	.....	.....	5,200§§	1,700§§
Attelboro	.....	.....	.....	.....	.....	.....	.....	.....	2	400
Boston	.....	.....	14,581	6,928	21,786	.....	.....	.....	.....	5,344
Braintree	¼	.....	.....	.....	.....	.....	.....	.....	.....	.....
Brockton	.....	.....	840	5,652	.....	.....	.....	.....	642,370	.....
Brookline	40,000	.....	.....	.....	.....	.....	.....	6,000	.....	.....
Chicopee	.....	.....	.....	11,570	.....	.....	9,072	.....	.....	1,720
Easthampton	3,500	.....	.....	.....	.....	.....	.....	.....	.....	600
Lee	.....	.....	.....	.....	.....	.....	.....	.....	2½	500
Lexington	19,09 1.5	.....	.....	.....	.....	.....	.....	.....	.....	45
Lynn	55,178	.....	19,745	.....	.....	.....	14,835	.....	.....	1,818
Millbery	.....	.....	.....	.....	.....	.....	½	.....	.....	.....
Orange	.....	.....	.....	.....	.....	.....	.....	.....	1	1,100
Pittsfield	.....	.....	.....	3,300	.....	.....	9,872	.....	.....	2,858
Somerville	3 5	.....	8,100	.....	.....	.....	.....	.....	.....	3,521
Spencer	2 500	.....	.....	.....	.....	.....	.....	.....	3,000	.....
Wakefield	.....	.....	.....	.....	.....	.....	.....	.....	11,000	1,100
Waltham	.....	.....	.....	.....	.....	.....	.....	20,000	.....	.....
Watertown	.....	.....	.....	.....	.....	.....	18.316	.....	.....	43,472
Michigan:										
Ann Arbor	.....	.....	.....	16,000	.....	.....	551	.....	50,000	3,055b
Crystal Falls	.....	.....	.....	.....	.....	.....	.....	7,872	.....	1,229
Detroit	.....	.....	½	.....	.....	.....	1,000	.....	2	25,000§
Dowagiac	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Flint	.....	.....	.....	.....	.....	.....	.....	.....	.....	350,000§
Grand Haven	.....	.....	.....	.....	.....	.....	1	.....	.....	.....
Ironwood	10,700	.....	.....	.....	.....	.....	.....	.....	.....	16,000§
Jackson	.....	.....	.....	5,000	.....	.....	.....	.....	.....	5
Lansing	.....	.....	.....	2,000	.....	.....	1,720	.....	.....	3
Muskegon	.....	.....	.....	3,000	.....	.....	.....	.....	.....	.....
Sturgis	.....	.....	.....	.....	.....	.....	.....	.....	.....	4,000b
Three Rivers	.....	.....	.....	.....	.....	.....	6,000§§	.....	1	2,800§§
Minnesota:										
Albert Lea	.....	.....	.....	3,000	.....	.....	.....	.....	1	.....
Cloquet	.....	.....	.....	.....	.....	.....	.....	.....	1	10,000§
Faribault	.....	.....	.....	.....	.....	8,700	.....	3	.....	.....
Laverne	.....	.....	.....	.....	.....	.....	7,000	.....	.....	.....
Minneapolis	.....	.....	.....	12.615	94,171	.....	19,618	.....	.....	28
St. Paul	.....	.....	.....	17,519	15,156	.....	6.215	.....	.....	44,000
St. Peter	5 8	.....	.....	.....	.....	.....	.....	.....	.....	.....
Virginia	.....	.....	.....	.....	.....	11,000	.....	.....	.....	.....
Winona	.....	.....	.....	.....	.....	.....	.....	.....	.....	48,000§
Mississippi:									500§§	.....
Canton	.....	.....	.....	.....	.....	.....	.....	.....	10,000	1,200
Clarksdale	.....	.....	.....	.....	.....	.....	.....	.....	2	.....
Laurel	.....	.....	.....	.....	.....	.....	700	.....	.....	.....
Missouri:										
Carthage	.....	.....	.....	.....	.....	.....	700	.....	.....	.....
Fredericktown	.....	.....	.....	.....	.....	.....	.....	.....	1††	200§§
Fulton	.....	.....	.....	.....	.....	.....	.....	.....	3,000	4,000§
Sedalia	.....	.....	.....	2,000	.....	.....	.....	.....	.....	2
St. Charles	16,896	.....	.....	3,000	.....	.....	.....	.....	1,000	.....
Montana:										
Great Falls	.....	.....	.....	.....	.....	.....	6,300	.....	.....	.....
Lewistown	.....	.....	.....	.....	.....	35,286	.....	.....	.....	.....
Nebraska:										
Lincoln	.....	.....	.....	14,328	.....	.....	659	.....	.....	161,831§§
Omaha	.....	.....	.....	19,600	.....	14,300	20,400	.....	.....	22,700§
Nevada:										
Reno	.....	.....	.....	.....	.....	.....	2,445	.....	.....	5.3
New Hampshire:										
Portsmouth	.....	.....	.....	.....	.....	.....	.....	.....	5	2,000§§

*—Information furnished by manufacturers. *—Vibrolithic. †—Cubic yards. §—Square feet. ‡—7000 Topeka on stone base; 3000 on concrete base. **—5 ft. wide. ††—5381 lineal feet, 30 ft. wide, asphalt filler; 3572 lin feet, sand filler. —Feet a—Blocks. b—Lineal feet. c—Dollars.

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems different will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

How to Unjoint and Handle Three Miles of Lead Joint, Small Size Cast Iron Pipe?

Excavate trench, exposing pipe completely; separate into convenient lengths by melting lead in joints; lift pipe to surface by shear legs and tackles or by jacking and melt out remaining joints with blow torch or cut out lead with machine.

January 29, 1921.

Editor, PUBLIC WORKS.
Dear Sir:

We notice in your publication, PUBLIC WORKS, that construction questions are answered and request that you give us some information as to the best method of unjointing and handling about 3 miles of cast iron pipe of sizes from 4 to 12 inches. Lead was used for all joints and trenches in which pipe is laid are about 5½ feet in depth. If you have any statistics on the cost of same would like to have them.

Yours very truly,
GENERAL CONTRACTOR AND BUILDER.

Unjointing cast iron bell and spigot pipes is an easy and comparatively simple and inexpensive matter for moderate size pipes laid in accessible dry trenches. Under ordinary conditions unjointing is quickly accomplished and the principal elements are time and cost of excavating the trench and back-filling it.

If the work can be done continuously and most of the line is unobstructed, and the character of the soil is adapted for it, it will pay to excavate the trench down close to the top of the pipe by one of several efficient trenching machines on the market which will uncover several hundred feet of pipe daily under favorable conditions and at a small cost as compared with ordinary hand labor. In unfavorable soil on steep grades, or in crowded city streets, it will probably be necessary to do all of the work by hand.

UNJOINTING ON SURFACE

If the soil is dry and firm and the trench may be opened for long distances without requiring sheeting or pumping, the 4-inch pipe may be unjointed at one point in the trench and one end of it hoisted to the surface of the ground, supported on a cross-piece spanning the trench, and the remainder of the pipe successively lifted to and supported to the same elevation by jacking and cribbing, or preferably by hoisting tackles operated from shearlegs spanning the trench and advanced from point to point as the pipe is elevated, without disconnecting additional joints in the trench.

As the size and weight of the pipe increases it will become too heavy to be handled in long lengths and too stiff to be bent into the inclined position, and it will be necessary to unjoint the pipe in the trench at shorter and shorter distances, thus dividing it into sections of three pipe lengths or more, each of which can be hoisted to the surface by any convenient method, probably that of shearlegs and hand windlasses, and there supported on skids for blocking while the remaining joints are opened. It will, of course, be more expeditious, convenient and economical, to open as many of the joints as possible on the surface of the ground and as few as possible in the trench.

UNJOINTING IN TRENCH

After the excavation of the trench has been carried by the machine, if one is used, as close as possible to the pipe, the remainder of the excavation must be made by hand, and at those joints which are to be broken in the trench the excavations must be enlarged around the bells of the pipe so as to provide access to all parts of them. The lead must then be melted out of these joints and the pipes separated, thus permitting them to be disengaged and one piece of the pipe to be hoisted to the surface.

Ordinarily the lead can be rapidly and satisfactorily melted by the use of a blow torch burning gasoline or kerosene, which is operated under air pressure and directs the flame to any given point of the joint, thus concentrating the heat and quickly melting the lead without injuring or disturbing the pipe coating except at the point of application of the flame.

A pan or other suitable receptacle should be placed under the pipe joint and the melting commenced on top of the pipe, so that the melted lead may retain the heat and promote the rapidity of work as the torch moves on down the sides, to the bottom, completing the joint. Two men with a torch should be able to open from thirty to forty joints per day on small-size pipes. Torches suitable for this purpose are manufactured and sold by the Hauck Manufacturing Company, 126 Crescent street, Brooklyn, N. Y., and by W. J. McLeod, Cincinnati, O.

If such torches are not available, it is practicable to melt out the joint lead by means of open fires built around the joints. The fires may be made from refuse wood or with coke which lights easily and burns well in open places, giving an

intense heat. The joints should be entirely covered, top, bottom and sides, with the fuel and care should be taken to save the melted lead.

UNJOINTING WITH MACHINE

After the pipe is elevated to the surface of the ground the intermediate joints may be melted out exactly the same as in the trench, or it may be possible to open them by the use of a pipe-cutting machine, some types of which are equipped with a cutting tool that moves around and around the pipe projecting into the space between the bell and spigot and gradually planing out the lead caulking. These machines can be more easily applied to the pipe after it is elevated on blocks or trestles than when in the trench. Cutting machines are generally possessed by the water departments of cities and large towns and may be purchased from the A. P. Smith Manufacturing Company, East Orange, N. J.; the Merrill Manufacturing Company, Toledo; the Williams Tool Company, Erie, Pa.; and from Curtis & Curtis Company, Bridgeport, Conn.

TRENCHING AND BACK-FILLING MACHINES

If conditions are favorable for the use of a trenching machine to excavate for the pipe removal they would probably be equally advantageous for back-filling the trench by machinery. This can be accomplished by various machines on the market that are specially designed for this purpose or some other machines already in the contractor's equipment that may be utilized to less advantage if they are not otherwise employed, as, for instance, a very light steam shovel or a plow or scraper hauled by motor truck or tractor. The most suitable plant, however, is some type of locomotive drag-line machine.

Trenching machines are manufactured by the Buckeye Traction Ditcher Company, Findlay, O., and both trenching machines and back-filling machines are manufactured by the Austin Machinery Corporation, Railway Exchange building, Chicago, and by Pawling & Hanischfeger, Milwaukee.

Boston Needs More Water

The chief engineer of the state department of health of Massachusetts, X. H. Goodnough, testified recently before the Committee on Water Supply of the State Legislature that the Boston Metropolitan District will begin to experience a shortage of water within the next five years unless steps are taken immediately to increase the supply. He urged the construction of a reservoir to be located at Enfield and to draw water from the water sheds of the Ware and Swift rivers, which would have a capacity exceeding that of the Wachusett reservoir and would cost at least $50,000,000. He stated that the population of the Metropolitan district has doubled in 30 years and is still increasing at the same rate and that it will be only two or three years before the consumption equals the total resources of the present reservoirs at Wachusett, Sudbury and Framingham, and Lake Cochituate, which latter is now in reserve. The city of Worcester has asked to be admitted to the Metropolitan water district as it has nearly reached the end of its water capacity; while Waltham, Newton and Brookline will soon be in a similar situation.

Mr. Goodnough said that "in 1920 we had the wettest year in the last 25 or 30. We have had a cycle of wet years. This wet season runs about 15 years. Within a very few years we will have a dry season and the places which depend upon the rivers for their supplies will be in a serious situation unless we prepare now to meet the situation."

Trade Schools Necessary for the Building Industry

The special Senate Committee on reconstruction and production, William M. Calder, chairman, has issued to the press a statement that his recent investigation and nation-wide survey of the housing situation of the country, including a questionnaire to every city and village in the United States, shows that the most important problem facing the nation to-day is that of obtaining sufficient skilled workmen in the building trade.

Senator Calder has therefore addressed to the governor of every state in the Union a letter urging the establishment of trade schools, in which he says, in part:

> One of the outstanding factors which is now hampering the building industry is the curtailment at the source of the supply of skilled tradesmen. The building industry is more highly organized than any other large industry but it is noticeable everywhere that its members are now getting along in years and in some trades the skilled young man is a rarity.
>
> It has been the experience of the past that the skilled mechanic in the building trades drops out very much earlier than in other trades and is forced to take up other less skilful employment. His pay has accordingly been somewhat higher than the usual run but the necessity for constant replacement has been ever present.
>
> The American youth takes kindly to the particular trades which require a little more skill than the others, and so we find among the electricians, the plumbers and the masons numerous young men of American birth, but such is not the case with the other trades.
>
> Heretofore, men from foreign shores, dissatisfied with the political and social conditions existing in their fatherland, have come to this country and, without serving a technical apprenticeship, they have started at the bottom of the ladder in the building trades. Those who have been worthy have risen to heights limited only by their ability. The country was a huge industrial training school where the building trades were taught largely to newcomers to our shores but the ravages of war cut off this source of supply and the result is apparent on every hand.
>
> The remedy seems plain—more apprentices. This goes to the essence, for without apprentices we shall soon be short of journeymen not only, but of foremen and practical employers. The problem is—How shall this be achieved? The best solution seems to be through the fostering of building trades schools. Some of the states have, under their labor codes, authorized a State Industrial Commission to operate an Apprentice Department. . . .
>
> Summarizing the above, I solicit your good offices in promoting the replacement of the fast dwindling supply of building tradesmen through an adequate system of trade schools which shall be conducted along lines mentioned above, and I request that you at your early convenient give me the benefit of your counsel as to what has been done in your state along this line or what you believe can be done.
>
> Very truly yours,
> (Signed) William M. Calder,
> Chairman.

Recent Legal Decisions

CITY FIREMEN NOT WITHIN PUBLIC WORKS EIGHT-HOUR DAY LAW

The California Supreme Court holds, Danielson v. City of Bakersfield, 193 Pac. 242, that a fireman, member of a paid fire department maintained by a municipal corporation, is not a laborer, workman or mechanic within the meaning of provisions in the State Constitution and statutes that the time of service of all laborers, workmen or mechanics employed upon any public works by the state, a county, or a municipality, is eight hours only.

ACTION ON PUBLIC WORKS CONTRACTOR'S BOND MUST BE BROUGHT WITHIN STATUTORY TIME

Kansas Civil Code, Section 662, provides that no action shall be brought on a public works contractor's bond after 6 months from the completion of the public improvement. The Kansas Supreme Court holds, Dickey v. United States Fidelity, etc., Co., 193 Pac. 346, that an action on such a bond which is not commenced until after 6 months from the completion of the work, although begun within 6 months after its acceptance by the municipal authorities, is barred by the statute. Acceptance might have been delayed by various causes which would not have delayed the time of completion.

COMPENSATION FOR INJURY TO EMPLOYEE TRANSFERRED TO SPECIAL EMPLOYMENT

The Wisconsin Supreme Court holds, Cayll v. Industrial Commission, 179 N. W. 771, that where an excavation contractor's employee consented to be transferred to the service of a gas company which was laying pipes in the ditches dug by the contractor, and was injured while working for the gas company, and under its control, the gas company, and not the contractor, was liable for compensation under the Workmen's Compensation Act; he having become an employee of the gas company under an implied contract of employment though he continued to work for the contractor one hour a day and was continued on his pay roll.

ACCUMULATION OF SNOW AND ICE ON SIDEWALKS

The Minnesota Supreme Court, following Smith v. City of Cloquet, 120 Minn. 50, 139 N. W. 141, holds, in McManus v. City of Duluth, 179 N. W. 906, that while mere slipperiness from the accumulation of snow and ice upon a sidewalk does not create a liability for injuries received in consequence thereof, yet there may be a liability where the municipality negligently permits an accumulation of snow and ice to such an extent, and to remain for such a length of time, that slippery and dangerous ridges and irregularities are formed therein from travel thereon, or other causes, thus rendering the walk unsafe and dangerous for public use.

SUBCONTRACTOR'S RIGHTS MEASURED BY VOIDABLE CONTRACST

A contractor for bridge construction with the city of Seattle without the consent of the city council sublet certain excavation work, so that the sub-contract was voidable by either party any time before such consent was obtained. The subcontractor abandoned the work when it was approximately half done and when it had been paid slightly more than half the contract price. The Washington Supreme Court holds, Dyer Bros., etc., Iron Works v. Pederson, 192 Pac. 1002, that the contract, though voidable, measured the compensation to which the sub-contractor was entitled, and it could recover nothing more from the contractor.

MUNICIPALLY OWNED WATER WORKS NOT SUBJECT TO EXECUTION

In an action against the Town of Lausalio, California, the sole question was whether the municipally owned water works of the town and its so-called franchise for supplying water to its people could be made the subject of levy and sale upon execution issued on a money judgment obtained against the municipality. The California District Court of Appeals, First District, in Marin Water and Power Co. v. Town of Lausalito, 193 Pac. 294, answered the question in the negative for the following reason: While it may be conceded that the grant to a private corporation of the right to exercise such a function as that of supplying water to a body of customers for a consideration in the way of tolls would be a franchise under the accepted definition of that term, the court does not think that definition is to be extended to similar powers and activities when these are being exercised by a public corporation by virtue of the powers possessed by it under the Constitution and Laws of the state. Nor can it be rightly extended to such powers and functions when exercised by a public corporation within the domain of its sovereign and under the authority and powers with which it is invested as such public corporation by the Constitution and Laws of the state, and sections 388 and 389 of the California Civil Code, providing for the sale of franchises under execution, has no application to such public uses.

In denying a rehearing of the case the California Supreme Court holds that the fact that the town is a public corporation does not determine the question whether or not its property is subject to execution. The true rule is that the property which it holds for the purpose of exercising its governmental powers or for the purpose of exercising its constitutional power to operate water works to supply its inhabitants with water or other like public purposes is not subject to execution; the reason being that to subject it to sale would interfere with the exercise by the city of some of the powers for which it was organized.

NEWS OF THE SOCIETIES

Feb. 28 — CHICAGO SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

March 1—INDIANAPOLIS CHAPTER, AMERICAN ASSOCIATION OF ENGINEERS.

March 1—CLEVELAND SECTION AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Cleveland Engineering Society rooms.

March 2—MINNESOTA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. St. Paul Association. Open forum meeting.

March 4—METROPOLITAN SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Robert Treat Hotel, Newark, N. J.

NEW ENGLAND WATER WORKS ASSOCIATION. March meeting, Copley Square Hotel, Boston. Secretary, Frank J. Gifford, Dedham, Mass.

March 11 — ROCHESTER (N. Y.) ENGINEERING SOCIETY.

March 11—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies Building, New York City.

March 11-12 — NORTHWESTERN ASSOCIATION OF GENERAL CONTRACTORS. St. Paul Hotel, St. Paul, Minn.

March 14—AMERICAN ASSOCIATION OF ENGINEERS. The third annual railroad conference. Chicago.

March 15-17 — AMERICAN RAILWAY ENGINEERING ASSOCIATION. Chicago.

March 18—SCHENECTADY SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

March 23-24—AMERICAN WATER WORKS ASSOCIATION. Illinois Section. Annual meeting, Chicago, C. C. Habermeyer, Secretary, Urbana, Ill.

March 30—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Directors' meeting, Atlanta, Ga. Secretary, James T. Mulcahey, Yonkers, N. Y.

Apr. 8—ROCHESTER (N. Y.) ENGINEERING.

April 16—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Joint meeting with the Association of Iron and Steel Electrical Engineers. Pittsburgh, Pa.

April 18-23 — UNITED STATES GOOD ROADS ASSOCIATION. Greensboro, N. C.

April 21-22—BANKHEAD NATIONAL HIGHWAY ASSOCIATION. 5th annual convention. Greensboro, N. C. Secretary, J. A. Routree, Birmingham, Ala.

April 27—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention. Houston, Texas.

April 27-29—UNITED STATES CHAMBER OF COMMERCE. 9th annual meeting. Atlantic City, N. J.

May 9-11—AMERICAN ASSOCIATION OF ENGINEERS. 7th annual convention. Buffalo.

May 9-12 — SOUTH-WEST WATER WORKS ASSOCIATION. Oklahoma City. Headquarters Skirvin Hotel.

May 17-19—NATIONAL FIREMEN'S ASSOCIATION. Twenty-third annual convention. Fort Wayne, Ind.

June—CONFERENCE OF MAYORS AND OTHER CITY OFFICIALS, State of N. Y. 12th Annual Conference. Elmira, N. Y.

June 6-10—AMERICAN WATER WORKS ASSOCIATION. Annual convention at Cleveland, Ohio. Secretary, J. M. Diven, 153 West 71st St., New York.

June 7-9—NATIONAL FIRE PROTECTION ASSOCIATION. Annual meeting. San Francisco, Cal.

Oct., 1921—IOWA SECTION, AMERICAN WATER WORKS ASSOCIATION. Seventh annual meeting.

AMERICAN ENGINEERING COUNCIL

Lawrence Wilkerson Wallace was elected secretary of American Engineering Council at the meeting of the executive board in Syracuse, N. Y., on February 14, succeeding L. P. Alford, of New York, who has been acting secretary since the formation of the council in Washington on November 19, 1920. Mr. Wallace has been one of the most active figures in the council and from the time it was organized has been its treasurer. As vice-chairman of the council Mr. Wallace has been directing the work of the committee on Elimination of waste in industry, one of the principal committees of the council whose scope following the Syracuse meeting will be greatly broadened.

Mr. Wallace, now at the temporary headquarters of the council in the Engineering Societies' building, New York City, will soon transfer his activities to Washington, where the council has established permanent national headquarters in the McLachlen building. The Employment Service Bureau will be continued in New York, where Walter V. Brown is in charge.

The council, at the Syracuse meeting, gave formal approval to the action of the committee on procedure requesting that President Harding put an engineer on the Interstate Commerce Commission. The procedure committee was authorized to name six qualified engineers when requested to do so. Activity in behalf of a National Department of Public Works will be continued by the council through the Public Affairs Committee. It was recommended that engineering efforts be extended to the whole question of government reorganization planned under a special congressional committee.

The plan for the registration of engineers as presented in the council's report was endorsed and the appointment of another committee was authorized. The Russian Affairs Committee was made a new committee on International Relations, the personnel of the old committee being retained.

An invitation from Philadelphia engineers to hold the April meeting in that city was accepted. The June meeting will be held in St. Louis.

The council decided to recommend to President Harding that an engineer be appointed assistant secretary of war. No action was taken relative to the National Civic Federation, Fuel Conservation, or Merchant Marine Committee appointments. The Committee on Public Affairs was authorized to recommend the congressional appropriation to investigate deeper waterways—St. Lawrence project.

THE NEW ENGLAND WATER WORKS ASSOCIATION

The March meeting of this association will be held at Copley Square Hotel, Boston, March 9.

Program: 11 a. m., meeting of the executive committee at the headquarters, Tremont Temple. 1 p. m., lunch will be served at Copley Square Hotel. 2 p. m., papers, "Pipe Extension Charges," by Nicholas S. Hill, Jr., consulting engineer, New York City.

"Cast Iron Pipe, the Method of Manufacture and Its Inspection," by William R. Conard, consulting engineer, Burlington, N. J., illustrated.

AMERICAN ROAD BUILDERS ASSOCIATION

The annual meeting and exhibition of this society was held at Chicago on February 9-12. A large attendance was present, and all joined in the discussion of technical papers, showing a lively interest which made the convention highly successful. And the exhibition of equipment and materials was excellent, notable both for its size and variety.

At sessions devoted to sub-grade design and research, probably the highest point of interest was reached. Important speakers on this subject were H. G. Shirley, F. H. Eno and Clifford Older. H. C. Sylvester, Jr., presented a paper on highway finance which was given great importance. W. A. Rogers, R. G. Collins and A. R. Hirst then addressed the meeting on the subject of contractual relations.

The chief business of the meeting was the presentation and discussion of resolutions. No formal action was taken as to the place of the next meeting, but Chicago was favored because of its central location.

COLORADO SOCIETY OF ENGINEERS

At its annual meeting on January 19, the Colorado Society of Engineers elected the following officers: President, F. C. Dreher; vice-president, R. M Hosea; secretary, C. M. Lightburn. The following addresses were given: "Engineers' Problem of the West," by Fred. J. Lucas; "Transportation," by John Crook; and "Engineers' License Law," by Senator Walter O'Brien.

PROVIDENCE ENGINEERING SOCIETY

This society at its fifth annual banquet on February 1 was addressed by Professor William J. Cunningham on "Federal Control of Railroads." Arthur P. Russell, vice-president of the N. Y., N. H. & Hartford R. R., also discussed the subject.

JAMESTOWN ENGINEERING SOCIETY

The Jamestown Enginering Society was organized at a recent meeting with the following officers: President, Walter F. Shaw; vice-president, E. C. Dollard; secretary, H. G. Garlock, and treasurer, F. A. Irvine.

UNITED ENGINEERING SOCIETY

The United Engineering Society, New York, at its annual meeting held on January 27, elected the following officers: President, J. Vipond Davies; first vice-president, Calvert Townley; second vice-president, W. L. Saunders; secretary, Alfred D. Flinn; treasurer, Joseph Struthers; assistant treasurer, George H. Pegram.

IOWA ENGINEERING SOCIETY

The directors of the Iowa Engineering Society have elected Lloyd A. Canfield of Des Moines secretary-treasurer to succeed John H. Dunlap, who was chosen president at the annual meeting on January 20.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

STAMP MIXER LOADER FOR CONCRETE HIGHWAY WORK

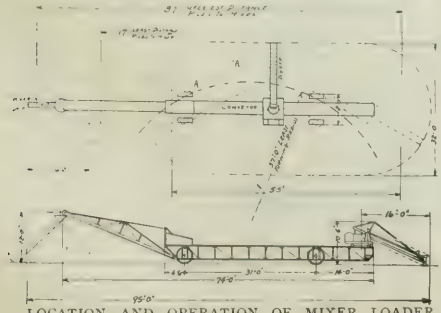
The Stamp mixer loader, manufactured by the Stamp Machine Co., picks up sand and stone from ground storage piles, measures them to exact proportions and conveys them in measured batches to the mixer. It is suitable where material is dumped on the subgrade, or where the material is piled at stations or intersections. On building work it takes the place of costly overhead bins and devices. It consists primarily of a long, longitudinal, structural framework, mounted on self-propelled truck wheels with the rear end inclined upwardly. A rubber belt conveyor of standard design is mounted in the lower part of this steel framework. This runs continuously and material dropped on to same is carried at a speed of 400 feet per minute and discharged into the mixer skip.

The top of the framework carries the elevating unit or digger elevator, mounted on wheels and movable back and forth longitudinally. The end can be raised and lowered and also swung in a complete horizontal circle. A separate four-cylinder, gasoline engine is used to drive this digger-elevator. It is fitted with power feed back and forth along the frame. The operator can quickly and easily adjust it to dig at any part of the material piles, on either side of the machine. The buckets, when worked to full capacity, will elevate about ¾ cubic yards per minute.

The buckets never work closer than 3 or 4 inches from the ground. A man who can be trained to be careful, cleans up the material and shovels it into the buckets. The digger-elevator discharged into a measuring hopper, with a number of adjustable, graduated compartments that is moved along the frame by a cable. To begin, all compartments of the hopper except one, sufficient for about 6 to 9 batches, are filled with sand. Then the digger is swung to work on the stone pile. As the compartments of sand are emptied (one to a batch), they are refilled with stone. In this way the hoppers serve as a storage for one material while the digger is working on the other. The digger operates approximately, during the time required for three or four batches on sand and six to eight batches on stone.

The Stamp mixer loader is equipped with a forward and reverse traction mechanism, operated by a 25 h. p. 4-cylinder gasoline engine which also operates the left conveyor. It is also equipped with a 4-wheel steering device which makes it easy to turn corners at a small radius. The front section beyond the wheels, and the rear inclined section, can be easily disconnected for shipment. The main framework, with the digger-elevator, will occupy the length of a flat car.

The manufacturers claim that a mechanical loader will enable contractors to use larger mixers on roadwork, and that with material stored on the grade delays are eliminated, so that the mixer can be operated to full capacity 10 hours per day.



LOCATION AND OPERATION OF MIXER LOADER COMMANDING 32 x 87 FOOT SPACE BEHIND MIXER

HANDLING AND MEASURING AGGREGATE FROM SUB-GRADE PILES TO PAVING MIXTURE

WESTINGHOUSE STREET LAMPS

Circular 7A-C-2 has been issued by the Westinghouse Electric & Manufacturing Company, Gorge Cutter Works, South Bend, Indiana, describing and illustrating the Westinghouse Luxsolite fixtures for street lighting. Style numbers and data on these fixtures, together with prices, are given in this circular.

The C I. type (cast iron) Luxsolite fixtures are used with Westinghouse Mazda C lamps in the same manner as former types of Luxsolite fixtures for the righting of residential streets, parks, and other large outdoor spaces. Their very rugged construction makes them especially useful for the hard service required of street lighting fixtures—the cast iron casings cannot be dented. For districts requiring an extraordinarily sturdy and compact unit the cast iron fixture, by reason of its additional ruggedness and weight, is especially valuable.

The weight of the Type C I Luxsolite fixtures has been kept well under that of the standard enclosed arc lamps formerly used, so that no difficulty may be experienced in the use of the same line equipment with the new fixtures.

A refractor of the skirted type is recommended where distribution of the nature given by refracting glassware is of advantage. The skirted refractor gives a good distribution of the light close to the horizontal angles and at the same time throws sufficient light on the street beneath the lamp to prevent the dim appearance produced by using the bowl-type refractor. The diffusing skirt cuts off the direct rays of the high intensity filaments, which are exposed when used with the band-type refractor. The skirted refractor thus gives the advantages of both the bowl-type and band-type refractor with comparatively little reduction in candlepower at angles close to the horizontal, or in the overall efficiency of the complete unit.

DRIVING A 75-FOOT PILE TO FULL PENETRATION IN 10 MINUTES WITH DOUBLE ACTING STEAM HHAMMER

McKIERNAN-TERRY STEAM HAMMERS

Bulletin No. 28 of the McKiernan-Terry Drill Company gives drawings and specifications of eight sizes of double acting steam hammers with net weights of 145 to 13,100 pounds and extreme length of 95 inches. They have strokes of 3¾ inches to 18 inches, delivering blows of 98 to 22,086 net pounds energy, and requiring boilers of from 10 to 60 h. p. or from 75 to 600 cubic feet of compressed air per minute. They will drive round piling to a penetration of from 6 to 60 feet in average material.

These hammers were the first double acting pile hammers commercially introduced in America, and are especially advantageous for driving sheet piles and batter piles and for extraordinarily hard driving. The smallest size, used for driving light sheet piles, can be handled without tackle and the larger sizes are used in a reverse position for pulling sheet piles which are thus very effectively removed under difficult conditions.

Some of the largest piles ever driven, consisting of two timbers bolted together, making a combined cross section of 15½ x 15½ inches, were 70 feet long and were driven at the rate of two per day penetrating 25 feet through gravel in the bed of the Thames river, London, where a five-ton drop hammer required four days for driving the same piles.

The accompanying illustrations shows one of these hammers driving 48 70-foot piles with 18-inch butts, in one day without jetting and without injury, where similar piles of the same job, driven by 6,500-pound drop hammers and hydraulic jets, were driven much more slowly and were badly injured by driving. The bulletin contains numerous pictures and data of pile hammers installed on different jobs which are briefly described.

INDUSTRIAL NOTES

The Combustion Engineering Corporation, New York City, has opened a branch office at 521 Candler building, Atlanta, Ga., in charge of A. A. Hutchinson.

The name of the Whiting Foundry Equipment Co. has been changed to the Whiting Corporation. The general offices and works of this corporation are located at Harvey, Ill., where they manufacture electric traveling cranes and complete foundry plants.

The Lake Shore Motor Bus Corporation, a holding company, has taken over the business of the American Motor Bus Corporation and the Chicago Motor Bus Company.

Joseph E. Nelson & Sons announce the appointment of J. B. French, as chief engineer of the firm.

PERSONALS

Mills, Thornton A., has accepted a position as civil engineer, Department of Public Works, Manila, P. I.

Letts, Joseph C., has been appointed construction engineer in the U. S. Public Health Service, with headquarters at Waukesha, Wis.

Garvin, Samuel H., has been appointed city engineer of Bowling Green, Ky.

Yorath, C. J., has been appointed commissioner of public works and utilities at Edmonton, Alberta.

Pearce, W. G., has been appointed assistant designing engineer of the sewer section, Department of Public Works, Toronto.

McKinnon, Ronald, has been appointed city engineer of Sydney, N. S., to succeed N. K. Hay, who resigned.

Goebel, Norman J., has been appointed engineer for the Board of Water Commissioners, to succeed W. G. Worden, who resigned.

McClenahan, Robert A., has been appointed city engineer of Astoria, Ore.

Shaffer, Philip H., has been appointed engineer of Somerset county, Pa.

Parks, O. E., has been appointed superintendent of highways, sewers and water works of Westfield, Mass.

Stevenson, D. W., has been appointed to the Florida State Road Department to succeed Edward Scott.

Tee, Alfred S., for 14 years city engineer of Astoria, Ore., has resigned.

Cade, K. C., has resigned as county engineer of Dickerson county, Texas.

Johnson, W. D., has recently been appointed engineer of Black Hawk county, Ia.

Atkins, Dudley, Jr., has been appointed county engineer of Osage county, Kan.

Tutewiler, Charles A., has resigned as member of the Florida State Road Department.

Dobbin, Jay H., has been appointed to the Oregon State Highway Commission.

Kennedy, J. E., formerly city engineer of Vancouver, B. C., Canada, died recently at Owen Sound, Ont.

Dilling, A. W., has been appointed chief engineer and S. T. Smetters maintenance engineer of the Sanitary District of Chicago.

Kennedy, C. H., has been appointed general sales manager of the Kennedy Valve Co., Elmira, N. Y.

Hendry, W. A., of Halifax, N. S., has been appointed chief engineer to the Provincial Highways Board of Nova Scotia.

Wright, C. R., is now assistant engineer for the Port of Grays Harbor at Aberdeen, Wash., in charge of all harbor improvement work under the direction of C. A. Strong of Tacoma, Wash.

McFarland, Robert, has been appointed superintendent of water works, Brandon, Manitoba, Canada.

Blanchard, Arthur H., consulting highway and transport engineer of Ann Arbor, Mich., has been engaged by the city of Colorado Springs in connection with its $1,200,000 paving program.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879.

Vol. 50 FLORAL PARK, MARCH 5, 1921 No. 10

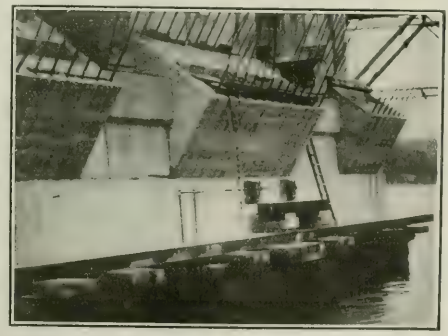
The Georgetown Bridge

$2,250,000 concrete arch structure 70 feet wide and 1,277 feet long to carry highway and trolley tracks across the Potomac on seven rib arch spans of 85 to 208 feet. Piers built in special sheet pile cofferdams. Concrete mixed in two plants.

The Georgetown bridge across the Potomac river is at the site of the famous old wooden canal aqueduct bridge built 80 years ago since replaced by steel trusses. It will connect M Street between 34th and 35th, Georgetown, D. C., with the U. S. Reservation at Rosslyn, Va. It is a monumental structure of reinforced concrete with seven segmental arch spans 85 to 208 feet long, carrying two 8-foot sidewalks, two 16-foot roadways, and two trolley tracks across the Chesapeake & Ohio canal, the street and the river at a maximum height of 72 feet from low water level to the intrados of the main arch span and 84 feet to the roadway. The main structure is 1,227 feet long and 70 feet wide and is extended to a total length of 2,700 feet by the approaches, one of which is curved 90 degrees.

The bridge, which is of a handsome type and impressive proportions, will be in the nature of a memorial to Francis Scott Key, author of "The Star Spangled Banner," whose home was near the site. It's construction was authorized by Congress in 1916 and has been provided for by appropriations totaling $2,250,000. It is being built by force account, under the direction of the Corps of Engineers, United States Army, who use for it floating equipment belonging to the War Department.

The superstructure is supported on five river piers 30 feet wide and three others of somewhat smaller dimensions, each of which carries three hollow reinforced concrete shafts about 85 feet high from low water level to the base of the parapet which protects the sidewalk on each side of the structure. The shafts are slightly battered and are ornamented by projecting courses and moldings at the spring line and at the top. The end piers form part of the abutments, having heavy longitudinal sidewalks to retain the interior fill on the sloping banks.



SKEWBACKS FOR ARCH RIBS AND SUPPORTS FOR ARCH TRUSS CENTERS.

The arch spans have three reinforced concrete ribs carrying, at the ends and on the haunches, transverse spandrel walls about 20 feet apart on centers, which support longitudinal spandrel arches. At the crown there are transverse spandrel walls about 6 feet apart which, with the spandrel arches, support the flat reinforced concrete roadway slabs.

MAIN PIERS

Each pier has triple shafts, one in the plane of each rib, with thick reinforced concrete exterior walls enclosing vertical walls covered on top by the roadway slabs. At each pier the two end shafts are duplicates and are smaller than the center shaft, from which they are entirely separate except for the top and bottom connections. The pier walls parallel to the axis of the bridge are planes and have a uniform thickness of 3 feet. The walls transverse to the axis of the bridge have a thickness of 1 foot 10¾ inches and are offset 1 foot 7¾ inches from the ends of the longitudinal walls so that the latter practically form pilasters at the corners of each shaft and additional pilasters are formed at the center points of the walls of the center shafts.

All of the walls are reinforced with ½-inch square vertical and horizontal bars near each surface. In the main piers the shafts are 30 feet wide in the direction of the bridge axis; the outer ones are 11 feet wide and the center one is 21 feet wide transverse to the bridge axis. The feet of the shaft walls are seated in recesses on top of the piers, and are filleted out to give them bearings about twice as great as the normal cross section of the wall.

MAIN ARCH

The center ribs of the main arch have a width of 21 feet transverse to the bridge axis and the side ribs have widths of 11 feet. The ribs, 11 feet 6 inches apart in the clear, are connected by deep trasverse braces 18 inches thick and about 20 feet apart. The vertical thickness of the rib at the crown is 5 feet 6 inches and the radial thickness at the skewback is 9 feet 6 inches. The clear span of the center and largest arch is 208 feet, and the rise of the intrados is 62 feet. The radius of the intrados is 108.8 feet at the crown and 142.5 feet at the haunches while that of the extrados is 124.8 feet at the crown and 148.7 feet at the haunches.

Each half of the arch rib is made with twelve sections numbered according to the sequence of construction from the crown down 1, 3, 5, 7, 9, 11, 10, 12, 8, 6, 4 and 2. Section 12 is a key section only about 3 feet thick which separates sections 8 and 10 forming construction joints with them. Section 13 also about 3 feet thick is the crown key with construction joints between it and sections 1-1, on opposite sides. The skewback bearings, radial to the arch curve, are recessed in the solid pier concrete to engage a shoulder of the arch rib.

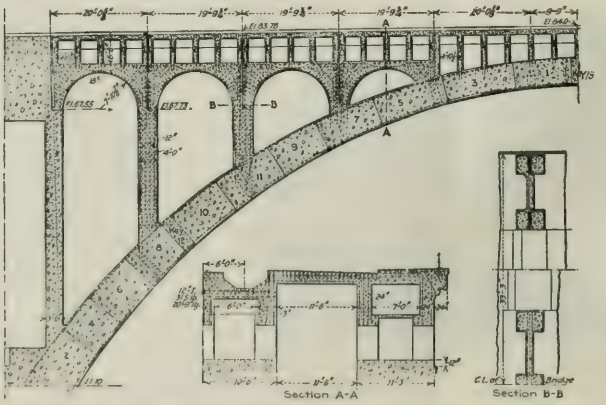
The arch ribs are reinforced by horizontal rods and rods parallel to the intrados and extrados that overlap successive sections. The lower ends of the vertical spandrel walls projecting a little beyond the extrados are connected integral with the sections of the arch ribs that support them and are bonded to them by bent reinforcement rods parallel to the arch ribs and parallel to the wall.

The spandrel walls support three full centered reinforced concrete arches of about 15 feet 10-inch span and one segmental arch, all concreted solid over the haunches to the horizontal surface at about the same elevation as the extrados at the crown. This forms a platform about 80 feet long, from the extremities of which at the haunches to center of the span there are, on top of the inch ribs, 12-inch transverse walls 4 feet 10½ inches apart at the centers. These walls carry the reinforced concrete floor slab 10 inches thick that is continuous from end to end of the bridge and from side to side, spanning the spaces between the arch ribs and provided with transverse expansion joints supported on double posts at the ends of the spandrel arches. Over the center rib there are depressions in the floor for the electric railway tracks, and the roadways and sidewalks are elevated sufficiently for drainage purposes. The other spans are similar to the center span.

CONSTRUCTION OF SUBSTRUCTURES

The excavation for the south abutment was carried down through 60 feet of old earth fill and to rock at the depth of 91 feet, the pit being sheeted and heavily timbered to resist the earth pressure from the steep hillside. Although there was a clearance at the surface of the ground of 3 feet between the neat line of the concrete and the face of the excavation when the work was started, the earth pressure was so great that it moved the entire timber framework 3 feet down hill and compressed the 12 x 12-inch waling timbers to a thickness of 6 inches where they took bearing against the horizontal cross struts.

The river piers were built on solid rock originally covered with 3 or 4 feet of mud and about 22 feet of water. They were constructed in 45 x 103-foot cofferdams, made with special combination sheet piles braced by an interior wooden framework. The piles were designed to utilize for preliminary temporary service part of the structural steel designed for permanent use in the roadway platforms. The male units were simple 12-inch, 31.5-pound I-beams with their flanges engaging recesses in the female units each of which was composed of two 7-inch channels with flanges turned in and a 5 x 5-inch full length wood filler bolted between their webs.



LONGITUDINAL VERTICAL SECTION THROUGH CENTER RIB OF 208-FOOT ARCH SPAN

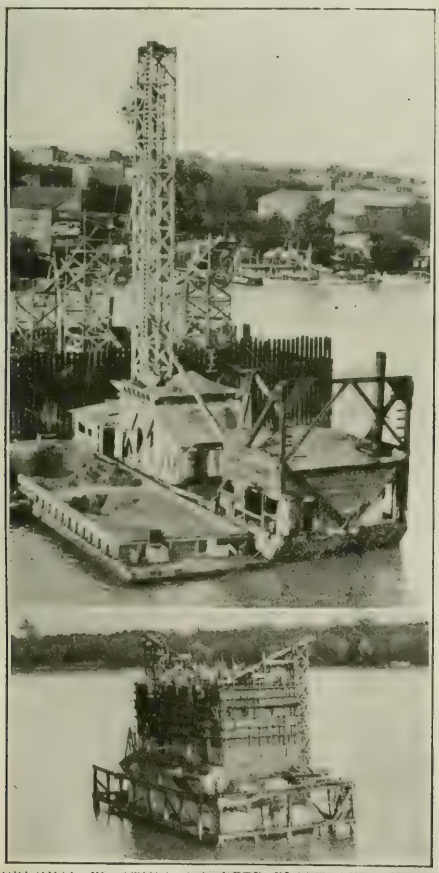
The cofferdam frameworks, requiring about 90,000 feet of timbers B. M., were completely framed and finished on shore, launched from ways, towed to position and sunk. Afterwards the sheeting around the framework was driven by a hammer installed in the swinging leads of a floating pile driver. Tide holes 8 inches in diameter were provided for safety and the mud and gravel in the bottom of the cofferdams were removed by an airjack, after which the cofferdams were sealed by depositing a 3-foot bed of concrete under water through a tremie. After the concrete had set the cofferdams were pumped dry in about six days each, using one

8-inch and one 5-inch pulsometer and one 6-inch Emerson pump. Afterwards they were kept dry by use of a single 5-inch pump.

CONCRETING

The piers were concreted in the dry and were built with heavy wooden forms handled by the floating derricks and the cable way and shifted upward as the work advanced.

Concrete was mixed in a plant on shore and delivered by a bucket operated by a Lidgerwood cableway of 1,700 feet clear span with stationary wooden towers 145 feet high. Additional concrete was mixed in a floating plant equipped with a 140-foot steel tower and sliding hopper with boom and truss spout line manufactured by the Insley Company. The pumping plant was installed on a boiler scow and there were in addition two derrick scows. Compressed air for the pulsometers and for pneumatic tools were furnished by one Ingersoll-Rand compressor. The floating concrete plant was equipped with a wooden hoisting tower and chute from which the concrete was in some cases spouted directly to position in the forms.



ORIGINAL FLOATING CONCRETE PLANT AND SHEET PILE COFFERDAM FOR PIER

PREST IMPROVED FLOATING CONCRETE PLANT

The skewbacks for the arch ribs were concreted integral with the piers and reinforcement rods parallel to the arch rib were left projecting from them to bond with the ribs.

The construction of the superstructure will be described next week.

The bridge is being built under the direction of Chief of Engineers, United States Army, Major M. C. Tyler, district engineer, and Major L. E. Oliver, resident engineer in charge of all field work.

Chicago's Paving Program

The Department of Public Works and members of the Council of Chicago have practically decided upon a repaving program covering 50 miles of streets on which there will be spent in 1921 approximately $5,000,000. The first step has been taken in advertising for bids for 7 miles of highways estimated to cost about $700,000. Council has appropriated $1,000,000 in the annual budget for the repaving work, with the idea that this would be replaced by a part of the $5,000,000 which it is expected to raise by a short-term repaving loan, when this shall have been approved by the legislature.

Amending Indiana Road Law

Senator Cann of Indiana has introduced a bill for amending the present road law of that state so as to require the county to pay half of the cost, the township 25 per cent and the abutting land owners 25 per cent, and requiring 200 petitioners instead of 50 to secure a road improvement. It was stated in the discussion that under the present law persons in cities or towns can force a county to improve a county road leading into that city. The present county unit law was passed in 1919 and has met strong opposition from the farmers over a considerable part of the state.

The Mount Pleasant Highway

Building 3.43 miles of concrete road with 1½ miles of service track and shifting batch boxes on and off motor trucks with gantry hoists. Convenient and economical cement house operations.

A 16-foot wide concrete highway 3.43 miles long, from Mount Pleasant to Boyds' Corner, Delaware, is a state aid job known as Contract CN-1, which was awarded last spring to Field, Barker & Underwood, Philadelphia, at a price of about $150,000.

The road is through rolling, sandy country with an alignment about 50 per cent curves up to 2 degrees, and tangents up to 1½ miles long. The construction involves 6,400 cubic yards of 1:2:4 concrete containing 10 per cent by volume of hydrated lime, and requiring 10,000 barrels of cement, 5,000 tons of sand and 9,000 tons of stone.

All of the materials are delivered by rail and the cement is stored in a cement house with a capacity for 6,000 bags of cement and 27 tons of lime. At one end of the cement house and on the same center line, there are a stone and a sand storage bin with capacities of 6 carloads and 3 carloads, respectively. Under the floor of the bins there is an 8 x 8-foot tunnel 125 feet long, in which the batch boxes are loaded through gates in the bottom of the storage bin.

In the cement house, in line with the gates in the stone and sand bins, there is a long open cement bin with three 6-batch cement boxes placed to correspond with the cars in the service train and provided with numerous gates discharging into a 3-bag trolley hopper that is easily set under any of the gates and, when filled, can be discharged into three of the batch boxes, moved to a convenient gate for refill, and then run back to fill the remaining batch boxes in the train, after which the train of batch boxes on flat cars is hauled out by a line operated by a hoisting engine and the cars are spotted under the stone and sand bins to receive the remainder of their charges, when they are hauled away by the gasoline locomotives, or by trucks.

Because the length of highway to be constructed is comparatively short, the work urgent, and new equipment expensive and difficult to obtain promptly, the contractor devised a plan to distribute concrete materials from the storage plant to the end of the line with the equipment on hand that did not provide for a service track the full length of the line.

The track was laid 1¼ miles from the stone storage yard and materials were hauled over it to the concrete mixer in the usual manner until the mixer progressed beyond the end of the track. The track was then moved ahead of the advancing mixer, and the materials transported from the loading plant to the end of the track in the regular batch boxes, loaded on industrial cars, the car and its load being hauled on motor trucks and trailers. This enabled a small equipment of railroad track and a small one of motor trucks, neither of which was sufficient for the entire work, to be advantageously combined and execute the work without involving additional installation of plant.

At the loading plant an elevated track was built from which the cars were run directly on to the trucks. The trucks and trailers were equipped with industrial track bolted to their platforms, the spaces between truck and trailer and trailer and elevated track being bridged with removable sections of track.

After the cars had been locked in position, the truck proceeded over the completed section of concrete road, which had been cured the specified time (30 days). At the end of this section the cars were transferred to another elevated track, from which they were hauled to the mixer by gasoline locomotives in the usual manner. A truck with its trailer carried four cars, each loaded with two 4-bag batches, or a total of eight batches per load. This method gave excellent satisfaction and no delay was experienced due to the method of transferring cars to and from the trucks. The best day's run of the season was made after the combination truck and locomotive haulage was in operation.

Water was pumped the full length of the line through a 2-inch main supplied from a well, and with a full force of 50 men the maximum progress on the work was 425 linear feet daily. The arrangements for handling the aggregate and those described in the cement house were considered advantageous and satisfactory, the latter providing for unloading and handling, measuring and storing cement at a cost of 75 cents per 100 bags, all the work being done with two men that would otherwise have been required to be on hand merely for unloading cars, so that their service in filling the batch boxes involved no extra cost.

The principal equipment installed for this work included one 3-bag Koehring concrete mixer, one 3-ton and one 6-ton Plymouth gasoline locomotives, 64 ½-yard Lakewood steel batch boxes, 28 Lidgerwood cars, 6,000 feet of Lakewood 24-inch service track with steel ties, one 3½-ton and one 6-ton Clydesdale automobile trucks, two trailers, one 1-ton Ford truck for general service, one 22-ton Erie steam shovel, one 10-ton Austin road roller, one American scraper and six wheel scrapers, one Austin scarifier, one heavy rooter plow hauled by the steam roller, one hoisting engine, 16,000 feet of Blaw-Knox steel road forms and one Lakewood sub-grader. The sub-grader proved a very desirable addition to the equipment, from the viewpoint of both the contractor and the engineer, as it insured an accurate, uniform subgrade.

The work was designed and executed under the direction of the State Highway Department, Charles M. Upham, chief engineer, and Samuel Knopp, principal assistant.

PUBLIC WORKS

Published Weekly
by
Municipal Journal and Engineer, Inc.
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates

United States and Possessions, Mexico and Cuba....$3.00 per year
All other countries ....$4.00 per year

Change of Address

Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

CONTENTS

THE GEORGETOWN BRIDGE—Illustrated 203
Chicago's Paving Program 205
Amending Indiana Road Law 205
THE MOUNT PLEASANT HIGHWAY 206
EDITORIAL NOTES 207
Writing for Technical Papers—Government Construction Careers
Day Labor Highway Construction 208
Two Large Dams Proposed in the West 208
City and County Hog Farm for Buffalo 208
Passaic Valley Sewer Injunction 208
Patrol Maintenance for Indiana Roads 208
PAVEMENT LAID DURING 1920—Table 209
HOW CAN BEACH SAND BE MOST ECONOMICALLY EXCAVATED AND LOADED IN TRUCKS?—Illustrated 211
A Water Works Wireless 213

Writing For Technical Papers

"Aside from scholastic training and his practical experience in industry or in the field, nothing contributes more to the progress of a young engineer than to form the habit of making acceptable contributions to the technical press.

"In the first place, it clarifies his ideas, leads him to think along logical connected lines, enlarges his vocabularly, teaches him precision in the use of terms and frequently forces him to fill in certain gaps in his knowledge or experience before he can give definite, comprehensive treament to any theme."

This advice was given by C. A. Tupper, president of the International Trade Press, at a conference held by the American Association of Engineers in Chicago, February 25th, and was supported by the citing of specific instances in which young engineers could trace directly to their contributions to technical papers a rapid advance to high position and salary. The preparing of such articles increases the writer's ability as an engineer, even if they are not published; and the publishing of them gives him a favorable publicity likely to lead to advancement in his present position or to facilitate his obtaining a better one.

The mere describing of commonplace matters neither increases his comprehension of a useful subject nor leads to the publication of the articles; but almost any engineer can find something of interest to write about. It may be a novel idea employed by the contractor or a development in engineering design. A comparision of the efficiency and cost of two or more methods of handling dirt or concrete on the same or similar jobs, or of the use of the same equipment or method under different conditions, furnishes a subject for investigation that is of great value to the engineer and furnishes material for an article of interest to others.

Articles of this kind are always most acceptable to this paper and are paid for by us; but the greatest value the writer obtains from preparing them is the training involved in his study of the subject and the publicity which he receives. In fact, this is the only form of advertising that an engineer can profit by. Those who do not employ it are neglecting a most valuable agent for their advancement.

Government Construction Careers

The largest and most vital interest in this country, exceeding even agriculture, is construction. It employs millions of workers and expends billions of dollars annually. It dominates, promotes, limits, delays or expedites all branches of production, manufacture, industry, transportation and commerce and is the essential of all progress and prosperity.

A very large proportion of construction is directed by federal, state, municipal and other public officers. The people's money used for this construction is expended for the people's good in a complicated manner, exposed to innumerable dangers from dishonesty, carelessness, neglect, extravagance, inefficiency and other evils.

The work is directed by thousands of officials, most of whom are underpaid in comparison with corresponding employees of private business and are largely at the mercy of political dictation, subject to promotion or removal without reference to their abilities or efficiency and having no certainty of appreciation or even of permanent employment. They have little material incentive to high or sustained achievement, although they are in positions to save or lose hundreds of times the amounts of their salaries. The turnover of public employees is great and should be largely eliminated.

In a recent address, Judge W. W. Warwick, Comptroller of the Treasury of the United States, strongly advocated that the public service be made a life career for the ablest young men. Associations of engineers, architects, contractors, educational institutions and all civic, technical and commercial organizations should urge that employees in public construction be appointed and retained solely on their merit, be discharged only for cause, and be advanced in proportion to their increased efficiency alone. They should receive compensation that, considered with regard to the responsibility, skill, surety of payment, prestige, dignity and other conditions involved, compares with that paid for similar services in private work.

In proportion as this is accomplished we will have prompt, efficient public construction excellently and economically executed. At present there is too much cause for the warning often

given to young men to avoid public office because it destroys their initiative and ambition, often leads to carelessness, unfits them for competitive work and may at any time leave them stranded.

Day Labor Highway Construction

In his report for the last quarter of 1920, A. R. Hirst, state highway engineer of Wisconsin, stated that "all the day labor jobs directly under control of the highway commission have been completed except project No. 110" and that the results have been very gratifying.

"The experience gained in these day labor operations is invaluable in that it gives the commission an insight into construction that could not be gained in any other way. The experience gained does not, however, prejudice the commission aginst contract work. It tends rather to make the commission more appreciative of the difficulties encountered by contractors and the experience gained by the commission in these day labor operations will be he best guarantee of fair profits to contracors who are willing and able to give due return therefor."

Two Large Dams Proposed in the West

Two unusually large irrigation propositions have recently reached the point of serious discussion, one of these being the construction of a retaining dam and diversion dam that would provide for irrigating 815,000 acres in the lower Rio Grande Valley; the other being the damming of the Colorado river by means of a dam nearly twice as high as any that has yet been constructed in the world.

The Rio Grande dam would be built in the Big Bend district 700 miles above the mouth of that river, where walls of solid rock rise 1,000 feet from the bed of the river on either side. The dam would be 250 feet high.

The Colorado river proposition has been reported on by Arthur P. Davis, director of the Reclamation Service of the United States. After an examination of several hundred miles of the river, he has recommended that the dam be located about 100 miles below the Grand Canyon. The dam would be more than 500 feet high. The Canyon here is 320 feet wide at the base and 750 feet wide at the level of the top of the proposed dam, thus being no wider than the site occupied by the Roosevelt dam, but the dam would be nearly twice as high. There would be the added difficulty that the foundation below the bed of the stream must be excavated for and built during eight months of low water, since during the spring floods any temporary works would be swept away and any excavations would be filled up. Mr. Davis says that bed rock would probably be found about 100 feet below the bed of the stream. This dam would back water up the Colorado river nearly 100 miles and thus nearly up to the Grand Canyon. The water would also back up many canyons leading off from the Colorado River Canyon on both sides. In fact, the principal storage basin would be in the valley of Virgin river, which flows into the Colorado river from the Nevada side. This would provide irrigation for lands requiring it up to 300 miles distant. In addition it would regulate the flow of the lower Colorado, thus eliminating the ever possible danger of overflowing the country along its lower stretches.

City-County Hog Farm For Buffalo

A hog farm to be operated jointly by the city and county has been proposed by Frank C. Perkins, Commissioner of Public Affairs of Buffalo. Mr. Perkins claims that the hog farm where Buffalo's garbage is now disposed of owes the city about $17,000 on its contract and that the price guaranteed to the city by the contract would pay little more than the cost of motor service required to deliver the garbage from the city to the farm. The price per ton depends upon the market price of hogs from month to month, and this makes the profit of the contract to the city all the more unreliable. Mr. Perkins recommends that the county receive the garbage from the city and feed it to hogs raised on the county farm, the work being done by the prisoners kept there.

Passaic Valley Sewer Injunction

An injunction suit brought by New York City to restrain the Passaic Valley Sewerage Commission from carrying the outlet of its sewer into New York bay at Robbins Reef, has been making its way slowly through the courts, and was before the United States Supreme Court in Washington on January 26. The case for New York was handled by Charles E. Hughes, while that for New Jersey was handled by George W. Wickersham, supplemented by Adrian Riker. It is expected that a decision will be handed down by the court some time in April or May.

The main point made by the New Jersey counsel was that the pollution which the Passaic Valley sewer would cause in New York harbor would not be nearly so great as that caused by New York City itself and that New Jersey has as much right to contribute its share to the pollution as had New York; coupled with the statement that New York discharges its sewage into the Hudson and East rivers and thus into the harbor with no treatment whatever, while the Passaic Valley sewage will be subjected to sedimentation, screening and chemical treatment also if this should be deemed necessary. While New York is now discharging some 900,000,000 gallons a day of crude sewage into the harbor, the Passaic Valley sewer would discharge less than one-tenth of this amount of clarified sewage effluent.

In its plea, New York stated that the Metropolitan Sewerage Commission and the Sewerage Plan Commission favored a disposal plant at Red Hook to cost more than $32,000,000, while an artificial island was proposed for another plant at a cost of more than $41,000,000. No definite steps, however, have been taken towards carrying out either of these projects.

Patrol Maintenance For Indiana Roads

It is reported that a bill will probably be passed by the Indiana State Legislature making radical changes in the present methods of maintaining county highways. It is estimated that more than $12,000,000 is spent by Indiana counties in main-

taining county roads and that a large part of this money is wasted because political influence largely dictates the selection of county road superintendents, the men filling these positions often being incompetent and even entirely unfitted for the work.

The plan proposed would do away with the present county road superintendents and substitute commissioners of county highways. Special educational requirements would be fixed by a state board for such commissioners and all applicants for positions as commissioner of highways would be required to pass an examination fixed by the board. The board would then certify to the county commissioners of a given county the names of three persons passing an examination for commissioner of county highways and one of these would be selected for the place. The county highway commissioner would have charge of road maintenance, which would be performed under the patrol system.

The act would also provide that all rules and regulations adopted by county highway commissioners must be approved by the state board.

It is estimated that the cost of maintaining improved county roads would average about $250 a mile the first year, or $7,500,000 for the 30,000 miles of improved highways in the state. After the first year, however, the amount required would decrease.

PAVEMENT LAID DURING 1920

(Quantities are square yards or miles unless otherwise indicated.)

Cities and States	Tar Macadam	Amiesite	Granite or other Stone Block	Brick or Clay Block	Creosoted Wood Block	Concrete Reinforced	Concrete not Reinforced	Plain (water-bound) Macadam	Gravel	Cement Sidewalks
New Jersey:										
Bordentown	.....	.....	.....	.....	.....	3,341	.....	.....	.....	1,000b
Camden	.....	.....	11,762	.....	.....	.....	2,590	.....	.....	1,000
Clifton	.....	.....	.....	.....	.....	.....	.....	.....	.....	29,750§
Elizabeth	.....	.....	8,208.3b	.....	.....	.....	.....	.....	.....	.....
Garfield	.....	.....	.....	.....	.....	.....	6,613	.....	.....	67,508§
Highland Park	.....	.....	.....	.....	.....	60,000	.....	.....	.....	2
Madison	.....	.....	.....	.....	.....	.....	5,700	.....	.....	200b
Montclair	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,500
Newark	.....	.....	15,325	144	.....	24,377	.....	.....	.....	.....
New Brunswick	.....	.....	.....	583	.....	.....	.....	.....	.....	.....
Passaic	.....	.....	775	.....	.....	.....	.....	.....	.....	.....
Plainfield	.....	.....	.....	.....	.....	.....	.....	.....	.....	10,000§
Red Bank	.....	.....	.....	.....	.....	3,740	.....	.....	.....	.....
Ridgefield Park	11,775	23,950	.....	.....	.....	9,290	.....	.....	.....	.....
Rutherford	3	.....	.....	.....	.....	.....	.....	.....	.....	½
Westfield	.....	.....	.....	1,200	.....	.....	.....	16,000	.....	160§§
West Orange	1	1½	2	.....	.....	.....	.....	.....	.....	2
New York:										
Binghamton	.....	.....	.....	.....	10,601.24	3,330.71	.....	.....	.....	.....
Bronx	.....	.....	179,581.1	.....	.....	.....	6,167.3	.....	.....	.....
Brooklyn	.....	.....	.....	.....	.....	.....	.....	.....	.....	225,000§
Buffalo	.....	.....	6,563	3,525	2,436	.....	.....	.....	.....	96,400§
Corning	.....	.....	.....	.....	.....	.....	.....	.....	.....	872§§
Endicott	.....	.....	.....	.....	.....	.....	.....	.....	.....	21,000§
Geneva	.....	.....	415	1,500	.....	.....	.....	.....	.....	.....
Herkimer	.....	.....	.....	.....	.....	8,250	120	.....	5,000	3,090§
Hudson Falls	.....	.....	.....	11,000	.....	.....	20,000	.....	.....	2,400§
Little Falls	1,248	.....	.....	.....	.....	8,224	.....	.....	.....	.....
Manhattan	.....	.....	59,523	.....	1,269	.....	.....	.....	.....	.....
Niagara Falls	.....	.....	.....	5,217	.....	.....	.....	.....	.....	.....
North Tonawanda	.....	.....	.....	.....	.....	.....	.....	5,500	.....	25,500§
Ogdensburg	.....	.....	.....	.....	.....	.....	.....	11,000	.....	.....
Olean	.....	.....	.....	2.37	.....	.....	.....	.....	.....	.....
Oneonta	.....	.....	.....	.....	.....	.....	.....	.....	½	2,297
Rochester	.....	.....	.....	.....	.....	.....	512	.....	.....	.....
Rockville Center	.....	.....	.....	.....	.....	.....	1	.....	.....	.....
Salamanca	.....	2,637	.....	11,870	.....	.....	.....	.....	15,000	25,000§§
Tarrytown	.....	.....	.....	.....	.....	.....	.....	3,000b	.....	500
Troy	.....	.....	.....	.....	.....	7,000	.....	.....	.....	.....
Watertown	.....	.....	.....	666	.....	1,440	1,350	22,000	.....	.....
Watkins	.....	.....	.....	.....	.....	.....	.....	.....	3,000b	.....
North Carolina:										
Asheville	.....	.....	.....	.....	.....	.....	1,213	.....	.....	.....
Durham	.....	.....	5,182	8,946	.....	.....	.....	.....	.....	11,200
Fayetteville	.....	.....	3,500	.....	.....	.....	.....	.....	.....	5,000
Greensboro	.....	.....	.....	.....	.....	.....	5	.....	.....	8
North Dakota:										
Bismarck	.....	.....	.....	.....	.....	35,000	.....	.....	.....	.....
Minot	.....	.....	.....	.....	.....	.....	.....	.....	1½	.....
Valley City	.....	.....	.....	.....	.....	.....	.....	.....	8,500	.....
Ohio:										
Akron	35,000	.....	.....	62,000	14,500	.....	4,930	.....	.....	80,000
Alliance	.....	.....	.....	39,000	.....	330	2,390	.....	.....	500
Bucyrus	1,200	.....	.....	.....	.....	.....	.....	.....	.....	1
Chillicothe	.....	.....	.....	.....	.....	.....	.....	.....	1.3	8.0
Columbus	.....	.....	.....	0.7	.....	.....	0.1	.....	.....	.....
East Liverpool	.....	.....	.....	16,000	.....	.....	.....	.....	.....	.....
Findlay	.....	.....	.....	1,418	.....	.....	.....	.....	.....	.....
Fremont	.....	.....	.....	9,800	.....	.....	.....	.....	.....	14,000§
Lancaster	.....	.....	.....	12,600	.....	.....	.....	.....	.....	.....
Lorain	.....	.....	.....	7,700	.....	3,400	.....	.....	.....	1,000
Marietta	.....	.....	.....	0.75	.....	.....	.....	.....	.....	.....
Marion	.....	.....	.....	22,900	.....	.....	.....	.....	.....	.....
Troy	.....	.....	.....	.....	.....	.....	.....	.....	70,000	16,000§
Xenia	.....	.....	.....	10,600	.....	.....	2,500	.....	.....	.....
Zanesville	.....	.....	.....	11,100	.....	.....	.....	.....	.....	.....
Oklahoma:										
Altus	.....	.....	.....	.....	.....	.....	.....	.....	.....	1½
Bartlesville	13,627	.....	.....	.....	.....	.....	46,730	.....	.....	.....
Durant	.....	.....	.....	8,600	.....	.....	.....	.....	.....	.....
Enid	.....	.....	.....	.....	.....	.....	47,278	.....	.....	.....
McAlister	.....	.....	.....	10,324.3	.....	.....	2,843.5	.....	.....	.....
Oklahoma	.....	.....	.....	.....	.....	.....	25,605.9	.....	.....	3,747
Wagoner	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,000§§

PAVEMENT LAID DURING 1920 (Continued)

Cities and States	Tar Macadam	Amiesite	Granite or other Stone Block	Brick or Clay Block	Creosoted Wood Block	Concrete Reinforced	Concrete not Reinforced	Plain (water-bound) Macadam	Gravel	Cement
Oregon:										
Astoria	.....	.....	.....	.....	.....	.....	19,991	.....	.....	.....
Corvallis	.....	.....	.....	.....	.....	.....	.....	.....	.....	5,520§§
Eugene	.....	.....	.....	.....	.....	.....	22,000	.....	2,000	5
Salem	.....	.....	.....	.....	.....	.....	8,444	.....	.....	80,000§
Pennsylvania:										
Allentown	.....	.....	.....	1,480	.....	3,516	.....	.....	.....	1.63
Altoona	.....	.....	.....	14,860	1,560	1,350	.....	.....	.....	.....
Berwick	.....	.....	1,760	.....	.....	.....	.....	.....	.....	2,000
Bethlehem	29,360	1,393	.....	4,410	.....	26,691	.....	.....	.....	11,999
Bloomsburg	.....	.....	.....	2,250	.....	.....	.....	.....	.....	.....
Bowmanstown	.....	.....	.....	.....	.....	½	.....	.....	.....	.....
Connelsville	.....	.....	.....	11,475	.....	.....	.....	.....	.....	.....
Duquesne	.....	.....	6,873	2,583	.....	7,437	.....	.....	.....	.....
East Bangor	.....	.....	.....	.....	.....	.....	.....	.....	4,000	.....
Easton	.....	.....	.....	.....	.....	.....	.....	.....	.....	6,000b
Freeland	.....	.....	.....	.....	.....	.....	.....	.....	5,000	1,200
Gallitzin	.....	.....	.....	5,000	.....	.....	.....	.....	.....	.....
Huntington	.....	.....	.....	1,500	.....	.....	.....	.....	.....	.....
Johnstown	.....	.....	.....	8,264	.....	.....	.....	.....	.....	.....
Lebanon	.....	.....	.....	.....	7,514	7,216	.....	.....	.....	56,000§
Morristown	5,709	1,700	.....	3,300	.....	.....	.....	.....	.....	.....
Parkesburg	.....	.....	.....	.....	.....	.....	.....	.....	.....	206
Rankin	.....	.....	.....	7,300	.....	.....	.....	.....	.....	2,500
Scranton	.....	.....	653.6	414.1	.....	.....	.....	.....	.....	.....
Sharon	.....	.....	.....	.....	.....	.....	8,989	.....	.....	5,000§
Stroudsburg	.....	.....	.....	.....	.....	4,508§	.....	.....	.....	.....
Titusville	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Wilkinsburg	.....	.....	.....	1,242	.....	1,154	.....	.....	.....	.....
York	.....	.....	.....	1,009	.....	.....	.....	.....	.....	.....
Rhode Island:										
Bristol	10,900	.....	.....	.....	.....	.....	.....	.....	.....	1,000
Woonsocket	.....	.....	25,280	.....	.....	.....	.....	.....	.....	1,080
South Dakota:										
Rapid City	.....	.....	.....	.....	.....	.....	.....	.....	.....	40,000§
Sioux Falls	.....	.....	.....	.....	.....	.....	5,003	.....	.....	.....
Tennessee:										
Cleveland	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,500
Dyersburg	.....	.....	.....	.....	.....	.....	.....	.....	.....	1,000
Texas:										
Amarillo	.....	.....	.....	.....	.....	.....	.....	.....	.....	4,000§§
Beaumont	.....	.....	.....	.....	.....	.....	.....	.....	25,000	100,000§
Belton	.....	.....	.....	.....	.....	.....	.....	.....	5	.....
Brownwood	.....	.....	.....	.....	.....	.....	.....	5,500	5,000	1,500
Clarksville	.....	.....	.....	.....	.....	.....	.....	.....	400	282
Cleburne	.....	.....	.....	.....	.....	.....	.....	.....	.....	5,000§
Dallas	.....	.....	.....	.....	.....	.....	1,785.1	.....	5,636	362,432§
Longview	.....	.....	.....	12,000	.....	.....	.....	.....	.....	.....
Porth Arthur	.....	.....	.....	.....	.....	.....	.....	.....	.....	½
San Angelo	.....	.....	.....	.....	.....	.....	.....	.....	10,500	6,000§
Temple	.....	.....	.....	5,000	.....	.....	.....	.....	25,425	18,220§
Waco	2	.....	.....	.....	.....	.....	.....	.....	20	10
Weatherford	.....	.....	.....	.....	.....	.....	.....	.....	4	1½
Utah:										
Ogden	.....	.....	.....	.....	.....	.....	.....	.....	.....	10,000
Provo City	.....	.....	.....	.....	.....	.....	34,908	.....	.....	6,105.4§
Salt Lake City	.....	.....	.....	.....	.....	.....	31,391.6	.....	.....	.....
Vermont:										
Burlington	½	.....	.....	.....	.....	.....	.....	.....	½	2
Middlebury	.....	.....	.....	.....	.....	.....	2,200	415	415	700§§
Montpelier	.....	.....	.....	.....	.....	900	.....	.....	.....	.....
Springfield	.....	.....	.....	.....	.....	.....	.....	.....	37,500	.....
St. Albans	.....	.....	.....	.....	.....	.....	.....	1	1	.....
Virginia:										
Charlottesville	6,000	.....	.....	.....	.....	.....	8,000	.....	.....	600
Clifton Forge	.....	.....	.....	.....	.....	.....	.....	2,000	.....	.....
Danville	.....	.....	3,200	2,466	.....	.....	16,000	.....	.....	4,862
Hampton	.....	.....	.....	.....	.....	.....	.....	.....	.....	150
Newport News	.....	.....	.....	.....	.....	.....	14,354.06	800.2	.....	.....
Norfolk	.....	.....	91,083	.....	496	.....	.....	.....	.....	.....
Washington:										
Charleston	.....	.....	.....	.....	.....	.....	6,000	.....	.....	100
Okanogan	.....	.....	.....	.....	.....	.....	.....	29,013	15,466	1,010
Olympia	.....	.....	.....	2,118	.....	.....	26,977	.....	.....	24,543
Raymond	.....	.....	.....	.....	.....	.....	3,000	.....	.....	2,000
Seattle	.....	.....	.....	46,153	.....	.....	277,365	.....	.....	.....
Spokane	.....	.....	.....	.....	.....	.....	2,923	.....	.....	4,989
West Virginia:										
Parkersburg	.....	.....	.....	4,723	.....	5,832	11,746	.....	.....	.....
Wisconsin:										
Augusta	.....	.....	.....	.....	.....	.....	.....	.....	.....	15,000§
Baraboo	.....	.....	.....	5,000	.....	.....	.....	.....	.....	.....
Beaver Dam	.....	.....	.....	.....	.....	.....	.....	½	.....	1
Beloit	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,000
Delavan	.....	.....	.....	.....	.....	8,000	4,000	.....	.....	.....
Eau Claire	.....	.....	.....	.....	.....	10,613	3,658	.....	.....	5,000§
Kaukauna	.....	.....	.....	.....	.....	.....	.....	.....	.....	2,000
Madison	.....	.....	.....	.....	.18	1.59	.....	.....	.....	.....
Manitowoc	.....	.....	.....	.....	.....	50,000	.....	.....	.....	.....
Marinette	11,800	.....	.....	.....	.....	.....	.....	.....	.....	4,800
Oshkosh	.....	.....	.....	.....	.....	.....	.....	.....	10,000	3
Racine	.....	.....	.....	37,664	.....	.....	.....	.....	.....	3
Rhinelander	.....	.....	.....	.....	.....	.....	.....	5a	.....	.....
Sheboygan	.....	.....	.....	.....	.....	6,100	.....	.....	.....	1
Superior	.....	.....	.....	.....	.....	26,000	.....	.....	.....	150,000§
Waukesha	.....	.....	.....	.....	.....	.....	.....	.....	.....	4,000§§
Wisconsin Rapids	.....	.....	.....	.....	.....	.....	.....	.....	1.8	1.5
Wyoming:										
Cheyenne	.....	.....	.....	.....	.....	.....	415	.....	.....	15,099b

*—Information furnished by manufacturers. §—Vibrolithic. †—Cubic yards. §—Square feet. ‡—700 Topeka on stone base; 3000 on concrete base.]"—5 ft. wide. ††—5381 lineal feet, 30 ft. wide, asphalt filler; 3572 lineal feet, sand filler. §§—Feet. a—Blocks. b—Lineal feet. c—Dollars.

Construction Questions Answered

How Can Beach Sand be Most Economically Excavated and Loaded in Trucks

For given conditions drag-line scraper bucket operated on a 400-foot slack cable is probably simplest and cheapest. With modified requirements and under special circumstances, dredges, conveyors, derricks, graders, wagon loaders, plows, cableways and steam shovels might be advantageous.

Office of County Surveyor, Ohio,
January 21, 1921.

Editor of PUBLIC WORKS:

Dear Sir: Along the beach of Lake Erie we have several places, such as shown on the enclosed sketch, where good, clean, sharp sand can be secured.

I am anxious to know what equipment and methods would be required to most economically remove this sand from the beach and place the same in trucks on the roadway, as shown.

Thanking you for any suggestion you may offer, I am,
Respectfully yours,
COUNTY SURVEYOR.

The most economical method and equipment for excavating, transporting and loading beach sand depends on whether it is meant to be the most economical in installation only or in cost per cubic yard for a given quantity handled, including entire cost of plant and operation, or for operating expense alone, without regard to cost of installation or salvage.

In either case, the cost cannot be estimated, and equipment and methods cannot be estimated, until several important factors are known, namely, the rate per hour at which the sand must be handled, the total amount to be handled and the kind of operating power available. The cost and methods will also be influenced in a lesser degree by the depth of cut, the character of material handled, the length of transportation, the height of hoists, the position and methods of loading, the plant or equipment available, and whether the plant is to be in temporary or in permanent operation.

ALTERNATIVE POSSIBILITIES

If a large amount of sand were to be excavated for a short period only, and a dredge or steam shovel were idle in the vicinity it might be most economical to use it and transfer the sand to the loading point on the highway or to build a ramp and extension of the road from the existing highway to the point of excavation and bring the trucks directly to the excavating machine. Almost any type of excavating plant might be utilized if special conditions made for specific economy, convenience, efficiency or rapidity or eliminated usual factors of cost. Ordinarily, however, they would not be best adapted for this service.

DREDGES

If an hydraulic dredge were used, it could deliver without difficulty to the elevation of the highway and the trucks could be loaded by gravity in a tunnel under the storage pile. A bucket dredge could deliver to a belt conveyor if one happened to be conveniently available, that would discharge sand on top of a storage pile or into an elevated storage bin, but these methods would hardly be economical unless there was an unusually good opportunity to secure the equipment at much less than the ordinary cost of installation and operation, or unless the excavation was under water or there was a very large amount to be done. They would, however, be effective.

CABLEWAY FOR VERY EXTENSIVE OUTPUT

If a very large quantity of sand was required and if, as is frequently the case on the lake shore, the deposit extended indefinitely beyond the limits of the 600-foot section indicated, it might be possible to handle it for a small unit cost by an excavating bucket operated from a cableway with movable towers traveling parallel to the shore line, an arrangement that would command all parts of an unlimited area and would elevate the sand to any required height for storage or chuting to delivery, but would involve a very heavy installation cost.

A hoisting and conveying bucket of any capacity can be handled on a semi-stationery cableway of 400 to 600 feet span, located in any required position on the area to be excavated. This cableway can be provided with a fixed head tower at the end of the highway with a mast, shear leg or other support for the tail tower. The cableway can serve and be located in any line and can be shifted readily by moving the tail tower and tail anchorage only, thus eventually covering all of the area and providing for the hoisting, conveying and dumping of the bucket that can deliver to a storage pile, to elevated storage bins, or directly to trucks.

Ordinarily the bucket would be filled by hand and it would be possible at considerable additional expense to apply the drag-line principle to filling the buckets with power furnished from the head tower of the cableway. This method might utilize the plant occasionally installed for handling spoil in sewer trenches, but is open to objection on account of the time and cost of shifting the tail tower and the cost of filling the bucket. In the sewer trench equipment the cableway moves parallel to itself, usually nearly the whole length of span at each shift and would thus command the 10-foot strip of coarse sand at the water's edge in this case. Of course the cableway might also be moved transversely to its length

and thus command also the 150-foot area of fine sand.

MECHANICAL LOADERS

The sand can, of course, be excavated by a standard elevating grader such as is used on road work, and which requires trucks to be continually moving alongside to receive the sand as it is discharged from the machine. This means the maintenance of a truck road from the end of the highway to different points of the sand pit.

If only the surface sand, above ground water line, is to be removed, it could probably be excavated and piled in long windrows by a road scraper or plow hauled by a tractor or heavy automobile truck, and loaded from the windrow into trucks by any of the several types of locomotive wagon loaders that could be used single or in multiple to give any required daily output. This, however, would involve the operation of the trucks from the highway to the loading machine, a feature which could easily be provided for by constructing a ramp and a corduroy road or even a rail track.

DERRICKS AND GRAB-BUCKET

Within a short distance of the loading point the sand could be excavated by clam-shell or orange-peel bucket operated from the long boom of a derrick and delivered directly to the trucks or to storage piles or storage bins and as the distance from the point of excavating to the point of loading increased, a very much greater area could be commanded by the installation of a second long boom derrick to handle the excavating bucket and transfer it to the other derrick serving the loading point, or to a trolley running by gravity on an inclined fixed cable and returned by a counterweight. These methods, however, and others that might be suggested, are more or less special, and would hardly be desirable unless the particular conditions involved made them unusually cheap or convenient.

DRAG-LINE SCRAPER BUCKET

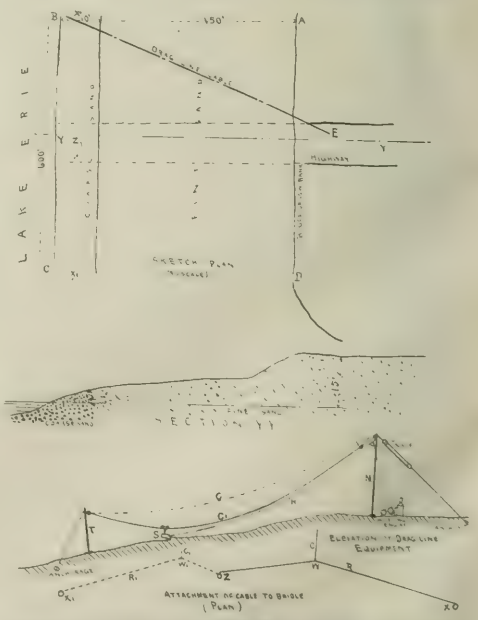
For ordinary conditions and an output of from 100 to 300 yards of dry, loose sand per day, excavated from the 150 x 600-foot area delivered at height of 10 or 20 feet above the surface of the ground at the middle of one of the long sides of the lot as indicated by the sketch, a drag-line scraper bucket plant is probably the simplest, the most quickly installed, the most easily operated, and the cheapest in original cost of installation and operating expense. It is not, however, suited to distances of more than 400 or 500 feet, or to the use of a very large excavating bucket, thus limiting the advantageous capacity from about 150 to 300 yards per day.

A very simple and efficient drag-line plant can be installed with the power located at E, on or near the roadway and the other end of a 400 or 500-foot cable located successively at different points on the two ends and along the shore line of the sand pit. The cable, made of plow steel, may have a diameter of about 1¼ inches and is supported at both ends on the tops of masts beyond which it is continued in the same plane to anchorages.

Both masts are properly guyed and both ends of the cables are secured to some stable objects, such as trees, heavy weights, or usually to dead men consisting of piles driven in the ground or buried timbers. The mast at the roadway is perhaps from 50 to 80 feet in height and near its top, on either side, the cable is connected to an adjusting tackle that permits the length of the cable to be varied during operation. The lead line from this tackle and the hauling line from the excavating bucket that is suspended from the cable are operated by a two-drum hoisting engine located on the ground near the foot of the main mast. The tail end of the cable is made fast directly to a dead man or to a bridle attached to two dead men or other anchorages.

The operating line of the drag-line bucket is made fast to the bucket and passes over a sheave at the top of the main mast and thence to the hoisting engine. A bucket of ½, ¾ or 1-yard capacity is suspended at a fixed distance below the trolley running on the main cable, and when filled by operating the hauling line is pulled upon the main cable by the continued operation of the hauling line until the bucket is dumped by coming in contact with a tripper attached to the cable above the storage or loading place.

After the bucket is emptied, the hauling line is allowed to overhaul and the bucket returns by gravity to the point where it is desired to fill it. The overhaul is then stopped and the adjustment tackle in the main cable is slacked off allowing the cable itself to sag until the bucket rests on the ground. The bucket is then dragged forward by the hauling line until it has filled itself, when



LOCATION OF DRAGLINE SCRAPER BUCKET PLANT AND DIAGRAMS OF ITS OPERATION

the adjustment tackle is again operated to take up the slack and make the cable taut, after which the bucket line is operated to haul the filled bucket on the cableway until it engages the tripper and is dumped, and so on, all of the work being done by two ordinary drums of a hoisting engine.

When all of the sand has been excavated in the plane of the cable, the tail end of the cable is shifted to a connection at another point on the bridle, all of the sand within reach is excavated, and the cable is shifted again, and so on, until the tail line has moved from end to end of the bridle. One end of the bridle is then detached from its anchorage, moved forward and attached to another anchorage and the cable is advanced step by step from end to end of the bridle and so on, as the work advances covering a maximum area of a complete circle with the main mast as a center and the full length of the cable as radius.

The end of the cable can have a fixed attachment to the bridle or it can have a movable connection adjusted by a hand windlass at one end of the bridle. The bridle is up to 100 feet long, and will provide for several positions of the cable and reduce the amount of shifting to a minimum.

DRAG-LINE EQUIPMENT

The main mast should be properly designed and fitted with guys, sheaves and other attachments designed for the specific requirements of the case.

The hoisting engine, although of standard double-drum type, is subjected to much heavier strain than in ordinary derrick work and it has been found that one suitable to withstand the stresses developed by the operation of a 1-yard scraper bucket will probably weigh 75 per cent more than one for ordinary service.

For handling a 1-yard bucket it will require a steam boiler of about 75 h. p. capacity or an A. C. electric motor of about 100 h. p. rating. The outfit will probably cost less than an ordinary sewer trench cableway of 500 feet span, and should have a capacity of 200 yards or more per day under favorable conditions.

Drag-line scrapers, cableways, masts and hoisting engines are designed, manufactured and installed by Sauerman Brothers, 1138 Monadnock block, Chicago, and by the Lidgerwood Manufacturing Company, 96 Liberty street, New York, both of whom maintain engineering staffs that are always available to answer inquiries, make estimates, design apparatus and advise concerning the selection and operation of plant and equipment. Under present conditions, when all manufacturers are desirous to keep their shops in operation, there is no doubt that very close prices will be quoted and equipment furnished as quickly and reasonably as possible.

SPECIFIC INSTALLATION AND OPERATION

The accompanying plan and cross section YY indicate the general character and dimensions of the location where the sand is to be excavated and loaded. The drag-line scraper may be installed with the main mast in the highway at E and tail mast at B and from its position where the main mast remains stationary the tail mast can be moved from B to A and from E to C and from C to D, thus covering the entire area.

If, however, it is desired to excavate only the long 10-foot stretch of coarse sand, the arrangement will be more efficient if changed so that the head mast is located at the point Z in the middle of the strip and the tail mast at X at one end. This will enable all of the sand between X and Z to be excavated and conveyed to Z and there delivered to the trucks arriving and departing on an extension of the highway carried from the bank to the lake shore for this purpose, as indicated by dotted lines. After this part of the sand has been excavated, the tail mast may be moved to the point X at the opposite end, while the main mast remains fixed and the sand between Z and X_1 can be excavated and loaded as before.

The sketch marked elevation of drag-line equipment illustrates the operation of drag-line EB previously explained and shown on the general plan diagram. In it M is the main mast and T the tail mast, both of them high enough to give the required elevation to the drag-line scraper buckets and hoist the material to a position from which it can be dumped to trucks or storage near the mast end and directly below the stop or trigger V on the cable which automatically dumps the contents of the bucket, when engaged by the latter.

The main cable C is hauled into the flat curve with considerable tension by operating the tackle led to the hoisting engine. When in this position the bucket S is run by gravity to a position vertically above the point at which it is required to excavate. The tackle is then slacked off, allowing the main cable to drop to position C_1, and permitting the scraper bucket to rest on the ground as shown. The hauling line H, which is attached to the bucket, passes over a sheave at the top of the mast and down to the hoisting engine, is then operated, causing the bucket to advance and fill itself, after which the tackle is again operated, pulling the cable back to position C, and thus providing a rigid support on which the bucket is pulled up to the trigger V by the continued action of the hauling line H. The bucket automatically dumps at this point and returns to the excavating position, the main cable drops to C_1, and so on, the operations being repeated over and over again.

In the figure showing the attachment of the cable to the bridle, the bridle R, any convenient rope or cable up to 100 feet long, is attached to piles, dead men, anchorages or masts X and Z and the cable C is attached to the bridle at any desired point W and maintained there until it is desired to shift the position of the cable when the attachment is moved forward to some other point between Z and X and again made fast, and so on. The movement either being made along the bridle by means of a special connection and windlass attached to one of the points of support or by an independent attachment made and shifted by hand from time to time. After the main cable has moved from X to Z the attachment of the bridle to anchorage X is removed and the end of the bridle is shifted to anchorage X_1, where it is made fast and the cable attached at any position W_1, to the bridle in its new position R_1, and so on, thus permitting the cable to move continuously from anchorage to anchorage with the minimum trouble and delay.

NEWS OF THE SOCIETIES

March 9—VERMONT SOCIETY OF ENGINEERS. Annual meeting. Hotel Vermont, Burlington, Vt.

March 9 — NEW ENGLAND WATER WORKS ASSOCIATION. Copley Square Hotel, Boston. Secretary, Frank J. Gifford, Dedham, Mass.

March. 10—ENGINEERS' CLUB OF TRENTON. Trenton, N. J.

March 10—TRI-CITIES SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Rock Island, Ill. Chamber of Commerce.

March 11 — ROCHESTER N. Y. ENGINEERING SOCIETY.

March 11—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies Building, New York City.

March 14—WATERBURY, CONN., SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

March 14—AMERICAN ASSOCIATION OF ENGINEERS. The third annual railroad conference. Chicago.

March 14-16—INDIANA SOCIETY OF SANITARY ENGINEERS. Muncie, Ind.

March 15-17 — AMERICAN RAILWAY ENGINEERING ASSOCIATION. Chicago.

March 17—BRIDGEPORT, CONN., SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Chamber of Commerce.

March 18—SCHENECTADY SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

March 22—PHILADELPHIA, PA., SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Engineer's Club.

March 22—ATLANTA, GA., SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Carnegie Library, Atlanta.

March 22—BALTIMORE, MD., SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Engineers' Club.

March 23-24—AMERICAN WATER WORKS ASSOCIATION. Illinois Section. Annual meeting, Chicago, C. C. Habermeyer, Secretary, Urbana, Ill.

March 25—COLORADO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Metropole Hotel, Denver.

March 25—METROPOLITAN SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Engineering Society Building, New York City.

March 30—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Directors' meeting, Atlanta, Ga. Secretary, James T. Mulcahey, Yonkers, N. Y.

April 11 — HARTFORD SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. City Club, Hartford, Conn.

April 16—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Joint meeting with the Association of Iron and Steel Electrical Engineers. Pittsburgh, Pa.

April 18-23 — UNITED STATES GOOD ROADS ASSOCIATION. Greensboro, N. C.

April 21-22—BANKHEAD NATIONAL HIGHWAY ASSOCIATION. 5th annual convention. Greensboro, N. C. Secretary, J. A. Boutree, Birmingham, Ala.

April 22—BIRMINGHAM SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with Atlanta, Birmingham and New Orleans sections, with members of Council present. Battle House, Mobile, Ala.

April 27—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention. Houston, Texas.

April 27-29—UNITED STATES CHAMBER OF COMMERCE. 9th annual meeting. Atlantic City, N. J.

April 28-29—MID-CONTINENT SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting of Chemical Eng. Societies. City Auditorium or Convention Hall, Tulsa, Okla.

April 29 — COLORADO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Metropole Hotel.

May 2-4—MISSISSIPPI VALLEY ASSOCIATION. 3d annual convention. New Orleans, La.
TRADE CONVENTION. 8th convention. Cleveland, Ohio.

May 4-7 — NATIONAL FOREIGN

May 9-11—AMERICAN ASSOCIATION OF ENGINEERS. 7th annual convention. Buffalo.

May 9-12—SOUNTHWEST WATER WORKS ASSOCIATION. Shirvin Hotel Headquarters, Oklahoma City, Okla.

May 9-12 — SOUTH-WEST WATER WORKS ASSOCIATION. Oklahoma City. Headquarters Skirvin Hotel.

May 17-19—NATIONAL FIREMEN'S ASSOCIATION. Twenty-third annual convention. Fort Wayne ,Ind.

June—CONFERENCE OF MAYORS AND OTHER CITY OFFICIALS, State of N. Y. 12th Annual Conference. Elmira, N. Y.

June 6-10—AMERICAN WATER TER WORKS ASSOCIATION. Annual convention at Cleveland, Ohio. Secretary, J. M. Diven, 153 West 71st St., New York.

June 7-9—NATIONAL FIRE PROTECTION ASSOCIATION. Annual meeting. San Francisco, Cal.

Oct. — IOWA SECTION AMERICAN WATER WORKS ASSOCIATION. Seventh annual meeting.

AMERICAN WATER WORKS ASSOCIATION, NEW YORK SECTION

A meeting of this section was held on Wednesday, February 16, at the Hotel McAlpin, New York, in the form of a luncheon and inspection and discussion of moving pictures showing trenching machines such as can be used in laying water mains. Lantern slides were shown by the Bucyrus Co. and the Marion Co., showing their steam shovels used in trenching for various purposes. The Parsons trenching machine and the Austin machine were shown in moving pictures which illustrated clearly methods of operating in city streets as well as open country. Following the pictures, questions were asked and experiences with trench digging machines were given by Messrs. Diven, Ackerman and two or three other members.

As member of the governing committee, in place of William W. Brush, whose term of office is expiring, the section elected Burt B. Hodgman.

NATIONAL FEDERATION OF CONSTRUCTION INDUSTRIES

The National Construction Conference called by the National Federation of Construction Industries was held March 2 and 3 at the Hotel Sherman, Chicago. The conference was announced to be for the purpose of taking steps to place the construction industry upon a more sound economic basis, and to inspire renewed activity in such industries upon improved conditions. The principal objects were, specifically:

To place construction materials upon a less erratic and more substantial basis of prices than now exists in many instances.

To set up machinery whereby adjustment may be made in labor costs, which will more properly accord with present conditions.

To develop modifications in the conditions surrounding the financing of the construction industries, which will tend to make more ready the supply of funds for this class of industry.

To make improvements in the relations between employers and employes, which will tend to secure the continuity of operations and a more satisfactory production in construction.

To aid employers and contractors in effecting such further deflation of values throughout the construction industries (and all stages thereof, from raw materials to finished products), including their own overhead and profit, as is required under present conditions.

AMERICAN ASSOCIATION OF ENGINEERS

A meeting of the National Engineering Conference on Public Information was held in the Congress Hotel, Chicago, February 25. Papers were presented on "Teaching Engineering Journalism at Iowa State College," by H. E. Pride, Bulletin Editor, Iowa Engineering Experiment Station, Ames. "The Necessity for Public Information in the Municipal Field," by S. C. Hadden, Editor of *Municipal and County Engineering*, Chicago. "Essentials of Popular Scientific Writing," by Alexander Black, Editor of the Newspaper Feature Service, New York. "The Value to a Young Engineer of Technical Press Contributions," by C. A. Tupper, President of the International Trade Press, Chicago. "Discussion on the Value of Technical and Engineering Press Bulletins." "Some Problems Before the Engineer," by John G. D. Mack, State Chief Engineer, Madison, Wis. "A National Program of Public Information," by W. W. DeBerard, Western Editor of *Engineering News-Record*, Chicago. "Ambassadors to His Majesty, the Public," by C. R. Thomas, in charge of Publication of Results, Forest Products Laboratory, Madison, Wis. "Engineering Information Service in Iowa," by R. W. Crum, Engineer of Materials and Tests, State Highway Commission, Ames, Iowa. "Making Easy Reading of Engineering Subjects," by C. S. Darling, Managing Editor of *Factory*, Chicago. "What Publicity Does for the Chapter," by R. C. Bailey, Assistant Secretary, American Association of Engineers. "The Difference Between 'Publicity' and News," by Harvey V. Deuell, of the *Chicago Tribune*. "The Meaning and Purpose of Publicity," by Ivy L. Lee, Advisor in Public Relations to the Pennsylvania Railroad and other interests. "Making Publicity Out of Policies," by Richard H. Waldo, Publisher of *Hearst's Magazine*, New York. "The Public's Debt to the Engineer," by F. M. Feiker, VicePresident of the McGraw-Hill Publishing Company, New York.

The subjects announced for discussion included: Shall we drop the term "publicity"? Germinating the public-

ity idea in the colleges. How can the technical press help disseminate public information? How can we stimulate the writing of special feature articles? Will publicity pay as a career? How publicity helps a community. How publicity helps a local society. Engineering publicity from the standpoint of the newspaper editor.

AMERICAN CONCRETE INSTITUTE

At the seventeenth annual convention of the American Concrete Institute held in Chicago on February 14, 15 and 16, technical subjects covering all phases of concrete were discussed. The meeting opened with an address on the "Aims and Activities of the Institute," by President H. C. Turner, and this was followed by a report by W. K. Hatt, a talk by W. A. Hull on "Recommendations for Safeguards Against Unusual Fire Hazards," papers by W. K. Hatt on "Tests of a Concrete Mixer," F. M. Balsley on "Equipment for Concrete Road Construction," C. R. Ege on "Developments in Construction Plant and Organization in Concrete Road Construction," and many other interesting discussions. Officers for the ensuing year are: President, H. C. Turner; secretary-treasurer, Harvey Whipple; vice-president, W. P. Anderson; and directors, Ernest Ashton, J. C. Pearson and D. A. Abrams.

IDAHO CHAPTER, AMERICAN ASSOCIATION OF ENGINEERS

The first annual convention of the Idaho Society of Engineers after it became a chapter of the A. A. E. was held on January 10-11 at Nampa. Action was taken requesting Congress to enact legislation to provide for the continuation of Federal Aid for highway work and for a National Department of Public Works. The following officers were elected for the ensuing year: President, Lee R. Cooke; vice-presidents, E. E. Moberly and J. H. Wilson; secretary-treasurer, Capt. E. F. Ayres; and executive committee, E. B. Darlington, Dr. C. N. Little and Barry Dibble.

ILLINOIS SOCIETY OF ENGINEERS

The annual meeting of the Illinois Society of Engineers was held in Chicago on January 26-28. A new feature of the meeting was the award of prizes for the best papers by writers of not more than five years' membership. The following men received prizes: Harlan H. Edwards, city engineer, Danville, Ill., for his paper, "Keeping Our Streets Smooth," and Allen Dimmick, of the Texas Co., Chicago, for his "Asphalt Pavements of the Future."

Officers for 1921 are: President, Samuel A. Greeley; vice-president, Robert I. Randolph; secretary, E. E. R. Tratman. The next meeting is to be held in Decatur, Ill., in January, 1922.

UTAH IRRIGATION AND DRAINAGE CONGRESS

At its fourth annual convention in Salt Lake City, January 17-18, the Utah Irrigation and Drainage Congress elected the following officers: President, Dr. F. S. Harris; first vice-president, R. E. Caldwell; second vice-president, E. A. Porter; third vice-president, Ephraim Bergeson; and secretary-treasurer, U. A. C. Logan.

LOUISIANA ENGINEERING SOCIETY

The regular meeting of the Louisiana Engineering Society was held at New Orleans on February 14. The technical exercises of the evening consisted of a paper, "Straightening a Large Shaft by the Heat Process," by Mr. Frank G. Frost, and an informal talk on coal handling machinery and cranes, illustrated by motion pictures, by Mr. Griess of the McMyler-Interstate Co., Cleveland.

INDIANAPOLIS CHAPTER, AMERICAN ASSOCIATION OF ENGINEERS

At the meeting on February 16, the chapter was addressed on "A Score Card for Engineers," by Dean Potter, of Purdue University. This talk related to a new method of rating students to encourage greater activities in university and engineering work, and the whole subject of engineering education was opened for questions and arguments.

The subject for the March 1 meeting will be "Some Recent Developments in Concrete," which will be discussed by Lieut.-Col. Boyden, of the Portland Cement Association.

ENGINEERING INSTITUTE OF CANADA

The 35th annual general and professional meeting of the E. I. C. was held at Toronto on February 1-3. There was a large attendance and all enjoyed the many social features of the meetings.

The council report showed the institute to be flourishing. There was a treasury surplus reported of over $6,000, and the membership has increased to a total of over 4,000. Two new branches have been added—one at Monckton, N. B., and the other at Sydney, N. B. Proposed amendments to the by-laws were discussed, and the discipline provisions were enlarged, and the fees raised. Prizes were awarded for the current year to E. E. Campbell, J. C. Nicol, Dr. A. Stansfield, R. deL. French and J. R. Dunbar.

The following officers were elected for the ensuing year: President, John M. R. Fairbairn; vice-presidents, H. G. Acres and Walter J. Francis. The secretary of the institute is Fraser S. Keith, 176 Mansfield street, Montreal.

NEW JERSEY SEWAGE WORKS ASSOCIATION

The annual meeting of the New Jersey Sewage Works Association was held on February 18. The following subjects were discussed: "Sewage Siphons," by Weston Gavett; "Certain Phases of the Biology of Sewage Disposal," by Thomas J. Headlee; "Practical Operating Data on Imhoff Tanks and Screens," by John Downes; and "The Design and Operation of Single-Story Tanks," by C. M. Nichols. There was also an open discussion on assessment methods for new sewers.

TOPEKA ENGINEERS CLUB

At its annual meeting on January 31, the Topeka Engineers' Club elected the following officers: President, M. W. Watson; first vice-president, A. B. Griggs; second vice-president, R. W. Epps; secretary, P. J. Carter; and treasurer, Roy Finney.

PERSONALS

Comer, R. O., has been placed in charge of canal and lock work on the Navigation Canal.

Hunt, J. R., has been appointed road engineer of Wyoming county, W. Va.

Smith, E. S., formerly Director of Public Service at Youngstown, Ohio, has been appointed chief engineer of the Ohio State Highway Commission.

Freeman, Roger M., for the past few years supervising engineer of the Bureau of Yards and Docks, U. S. Navy, has opened an office in New York City as construction engineer, specializing in the design and construction of industrial buildings, steel plants and power plants.

Herrick, Leon C., of Norwalk, Ohio, has been appointed State Highway Commissioner of Ohio.

Gibson, W. S., of St. Thomas, Ont., has resigned from the engineering staff of the Ontario Department of Highways, and will be succeeded by S. F. Hanning.

Bintz, W., formerly structural engineer of the Flint, Mich., Engineering Department, has accepted a similar position at Lansing, Mich.

Hayes, F. B., has been appointed city engineer of Pendleton, Ore.

Dimock, A. H., city engineer of Seattle, has been reappointed for a three-year term.

Leo, John P., chairman of the Board of Standards and Appeals, has been appointed commissioner of street cleaning New York City, to succeed Arnold B. MacStay.

Giesecke, Prof. F. E., head of the engineering division of the bureau of economic geology and technology, University of Texas, has been appointed chairman of the problem committee, Federal Highway Council, Washington, D. C.

Babcock, Dudley P., formerly assistant engineer of the New York State Highway Commission, is now assistant engineer, Bronx Parkway Commission, Bronxville, N. Y.

Jackson, Jesse A., who has been in the employ of the Seattle engineering department since 1902, has been appointed engineer of the Seattle City Zoning Commission and is developing a plan for laying out the city in zones.

Levin, Louis S., formerly engineer of Allegan county, Michigan, has been appointed roads engineer of Chippewa county.

Brooks, Clarence M., formerly of the New Hampshire State Highway Department, is now highway commissioner of Vermont.

Smyth, Sid, has been reappointed engineer of Cochise county, Ariz., for a term of two years.

Harrison, Major W. B., Corps of Engineers, U. S. A., has been ordered to serve with the 11th Engineers in the Canal Zone.

Groot, E. H., has been made assistant engineer in charge of the Louisville & Portland Canal.

Smith, Eliot N., for nine years on the engineering staff of the Catskill aqueduct, Board of Water Supply, New York City, died recently.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

EARLE CENTRIFUGAL PUMPS

The centrifugal pumps built by the Earle Gear and Machine Company comprise a full line of high-grade single and multi-stage pumps from 2-inch to 14-inch size for any type drive, from slow speed steam or gas engines to high speed steam turbines. They are built for any conditions for which centrifugals of the better class are adapted, except for deep well pumping.

This company was among the pioneers in the development of the modern centrifugal pump and has kept pace with the very rapid improvement in design during the past decade.

Earle pumps having all the good points of any other make, as well as some special features, comprise, when direct connected to a driving unit of proper size and type, a pumping outfit which is low in first cost, requires little foundation, is noiseless in operation, operates with minimum of attendance and repairs, and maintains its original high efficiency indefinitely.

Both single stage and multi-stage type have horizontally split casings with both suction and discharge openings in the lower half of the casing, thus permitting the complete dismantling of the pump without disturbing the piping connections. The construction of the bearing brackets integral with the lower half of the casing secures the permanent alignment of all parts of the pump with the shaft center line. All bearings are ring oiling, of liberal size, and are split vertically so that by a quarter turn they can be easily removed without displacing the shaft.

The shaft is protected from the action of the liquid handled by bronze sleeves, carried through the stuffing boxes which are provided with bronze water seal rings packed on both sides. The impellers are of bronze, enclosed type, fitted with removable wearing rings of the step type originated by the Earle Gear and Machine Company. The flexible couplings have steel pins in one-half which engage steel lined rubber bushings in the other half.

The multi-stage pumps are of the tried and proven type, with impellers all faced one way to obtain the shortest and smoothest water passages between impellers. The end thrust, which is practically the only undesirable feature of this type, is, in the Earle pumps, entirely eliminated by means of the "Simplex Pump Balance," a recently patented device which automatically counteracts the end thrust and continues to do so throughout the life of the pump.

This type of pump is particularly suitable for boiler feeding, or for any high pressure pumping requirements.

ROSS HYDRANT THAWING DEVICE

The Ross hydrant thawing device has been perfected and is now placed on the market by the American-La France Fire Engine Co. This thawing device is simple in construction, compact in design and effective in operation.

It consists essentially of a steam coil surrounded by a jacket tank, which is filled with water for pumping into the steam coil. By means of a hand-operated pump, water can be forced from the tank into the coils and by regulating this feel either wet or super-heated steam can be secured at the nozzle. Water is fed continuously into the coil and immediately converted into steam.

The heat is produced from a standard Presto-lite style B tank carried with the outfit. Although it is impossible for this boiled to explode in ordinary operation a safety valve is provided against any unforeseen condition.

The steam is led through 15 feet of flexible metallic hose with a braided steel jacket covered for over half its length with asbestos, which in turn is protected by a canvas cover, and the whole wrapping bound with wire.

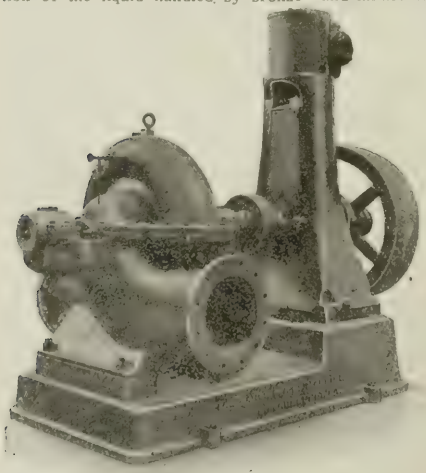
The entire thawing device weighs only 135 pounds completely charged ready for service. It is 28 inches across the base, 12 inches wide and 25 inches high.

The portability, the fact that the boiler is not dependent upon an outside source of heat, and the remarkable rapidity with which steam is produced, make this thawing device of general value and unusual practicability and of particular benefit to fire departments.

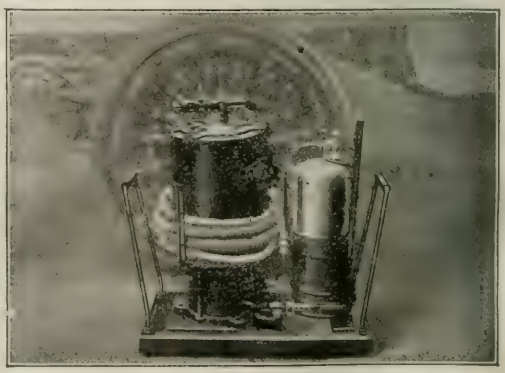
STANDARDIZED SECTIONAL STEEL BUILDINGS

The Steel Fabricated Corporation makes a specialty of the construction of standardized sectional steel buildings for industrial uses. They are built with standard type single span trusses 8, 10, 12, 16, 20, 24 and 30 feet long, with side-wall sections 8 or 10 feet high, and, in the heavy type, with single truss spans of 20, 24, 30, 32 and 40 feet and side-wall sections 10, 12 or 15 feet high.

Both types are one-story structures furnished in multiples of 8-foot lengths with frames made of riveted steel shapes covered with corrugated steel riveted to them. They may be placed on wood or concrete foundations and are furnished with sliding or swinging doors. The roof trusses are of the compound Fink type, and erection diagrams are provided by which the buildings can be assembled with common labor. A 40 x 496-foot building was erected in four working days. The buildings can be easily knocked down and re-erected and are recommended for a large number of industrial purposes.



EARLE CENTRIFUGAL PUMP



HAND PUMP HYDRANT THAWING DEVICE

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Entered as Second Class matter at the Post Office at Floral Park, N. Y., August 27, 1906, under the Act of March 3, 1879

Vol. 50 FLORAL PARK, MARCH 12, 1921 No. 11

Linden Street Sewer Tunnel

Method of shield excavation and driving, alignment and adjustment. Erection of concrete lining blocks. Adjustable supporting traveler. Backfilling behind shield tail. Grouting joints and backfill. Rapid progress and accuracy.

The Linden Street sewer, Flushing, L. I., has a circular cross-section 87 inches in interior diameter and is 1,022 feet long with a fall of 0.21 foot in 805 feet. The invert is a little below ground-water level in sharp, good building sand and 30 to 60 feet below the surface of the ground.

Competitive bids were received on alternative designs for pre-cast concrete lining, and for cast-iron segments lined with concrete. The bids for the latter exceeded those for the former by $30 a foot. The contract was awarded to the O'Rourke Engineering Construction Co. in March, 1920, the work to be completed in 350 working days, at a price of $155 per linear foot of tunnel and $74,000 for the four shafts, making a total of $371,910. On March 1, 804 linear feet of tunnel had been driven and the work was in advance of the schedule requirements.

The shield method is being used, operating with a single heading driven from a shaft at one end, through two intermediate shafts at each of which the alignment makes a horizontal angle of about 90 degrees.

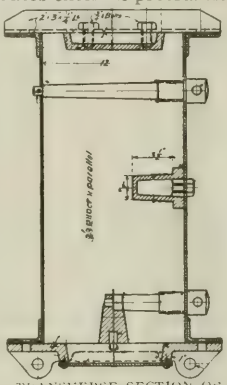
The tunnel is being constructed under the direction of the Bureau of Sewers, Borough of Queens, New York City. Before the contract was awarded, designing engineer Frederick Seeley visited the Ford tunnel at River Rouge, Detroit, which is 12 feet 8 inches in diameter and 5,500 feet long, for the purpose of studying its design and construction. The Ford tunnel was driven by the shield method and was lined with segmental concrete blocks 18 inches thick, employing novel methods and new appliances corresponding closely to those since adopted for the Linden Street sewer.

The lining consists of hollow cylindrical rings 7 feet 3 inches in diameter inside and 9 feet 3

BLOCK FORM AND BLOCK STRIPPED AND RESTING ON BASE PLATE

SEGMENTAL CONCRETE LINING BLOCKS, SEASONING IN STORAGE YARD COMMANDED BY TRAVELING CRANE

inches in exterior diameter. They are 27 inches long parallel with the axis of the tunnel and are completely enclosed by an envelope 3½ inches thick composed of small gravel that fills the cavity left by the withdrawal of the shield tail, prevents displacement of the ground and preserves alignment of tunnel and distributes external pressures.


TRANSVERSE SECTION OF BLOCK FORM

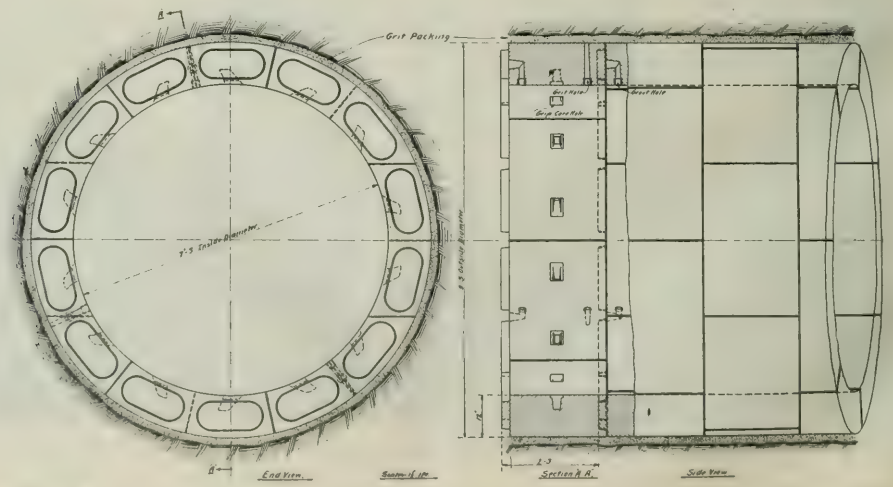
Each ring is composed of six duplicate interchangeable segmental blocks with radial joints and a key segment, weighing about 1,500 pounds. The radial joints are staggered one half the length of the segments in adjacent rings, an arrangement secured by shifting the key segments one half block right or left. Each segment block is provided on one vertical face with two 2¼-inch projections 17¾ inches long and 8⅞ inches wide, with tapered sides and rounded ends which engage corresponding recesses in the opposite faces of the segment in the adjacent range, the recesses being a quarter of an inch larger and with slightly greater taper to provide an opening to hold grout between the projection and sides of the recesses. It also provides an easy engagement and accurate adjustment and maintains the alignment.

One-third of the blocks are provided on the intradosal surface with grout holes leading to the middle of the transverse joints and with two 2 x 5-inch curved inclined grip holes 4¼ inches deep, to receive the jaws of the erecting device. There are also, near the rear vertical face of each block, two grout holes passing entirely through the block to deliver grout to the exterior of the tunnel ring. All of the grout holes are slightly tapered to a minimum diameter of 1 7/16 inches, and at the inner ends are provided with a special screw thread, cast in the concrete, to receive temporary nipples screwed in for the grouting connection.

The tunnel lining requires over 6,000 segmental blocks, all of which are cast on the surface of the ground at the top of the shaft at one end of the tunnel. Casting was commenced in the early part of August, 1920, and as the blocks are made at the rate of 36 daily, a considerable number were ready in advance of the commencement of the erection in December, and sufficient provision was made for their seasoning at least one month before their use, although it is considered that they could be safely assembled when two weeks old. On February 6, when the note for this description was made, more than 3,000 blocks had been cast and about 1,500 finished blocks were in the storage yard waiting to be used. The blocks are made with 1:2:4 concrete using ¾-inch broken stone, and are so carefully made that notwithstanding the rigid inspection none of them have been rejected.

The segmental blocks are cast with the curved side vertical, in steel forms with bent side plate 3/16-inch thick, countersunk, riveted to top and bottom exterior flange angles. The bottom flange angles are detachably clamped to cast iron base plates recessed for the interlocking projections in the transverse joints of the segments. The tops of the forms are open and receive cast iron core prints bolted to cross pieces that are accurately located on and attached to the upper flange angles to provide for the recesses in the faces of the blocks. Tapered steel and iron cores are attached to the forms to provide holes for the grit, grout and the erector grips.

Each form is nearly semi-circular in plan and is provided with two vertical radial dividing plates



CONCRETE BLOCK TUNNELS, SHOWING JOINTS IN LINING AND HOLES FOR GROUTING AND EXTERIOR PACKING

that separate it into compartments for three segment blocks having an angular length of 51 degrees, 25 minutes and 43 seconds, equal to a little more than 3 feet 2 inches on the intrados.

The forms, which were built by the Davis &

TRAVELING CRANE IN BLOCK YARD

Thomas Company, are about 12½ feet long measured on the extrados, 2 feet 3¾ inches high and 18 inches wide overall. Including the base plate they weigh about 3,000 pounds each. They are finished to an accuracy of 1/50 inch, so that the projections of the blocks are in perfect contact throughout the entire ring with the bottoms of the recesses in the adjacent ring, giving an even distribution of stress and avoiding the cracking or spalling of blocks when they receive the stresses due to shoving the shield.

Concrete is mixed in a ½-yard Ransome machine delivering to a pair of buckets suspended from an electric overhead traveling crane that commands the casting yard, which is about 24 feet wide and 100 feet long. The concrete, mixed moderately dry, forms a quaking mass that is thoroughly spaded in the forms until the small amount of water flushes to the top and overflows, after which the core prints for the recesses are forced into the upper surface of the concrete, displacing the excess material and leaving a stiff concrete which is accurately smoothed off to the plane of the finished upper edges of the form.

After the concrete has set five hours or more, according to weather and convenience, the forms are stripped, leaving the segment blocks on the cast iron bases until after the concrete is 18 hours old, when the blocks are removed and piled up in storage alongside the casting yard, thus releasing the bases for another set of blocks, and so on. About 11 yards of concrete are required for 36 blocks which are cast in 1¼ hours by a force of nine men.

(To be continued)

Good Concreting Records

The outlet work for the Taylorsville dam in the Miami Conservancy District is a massive concrete structure 241 feet wide, 628 feet long and 111 feet high, containing 45,000 yards of concrete, some of it placed in walls up to 50 feet thick. The concreting was done in about one year, during which the schedule proposed called for an average amount of 100 yards per 10-hour working day for about five months and 200 yards per day for the remaining time, an amount which was not quite reached until near the end of the job, when it was exceeded. The records were 568 yards in one day, July 29, and 2,408 yards in one week and 9,280 in 27 consecutive working days.

The original estimate of cost was $9.47 per yard and the actual cost was exactly $10 per yard, composed of $3.51 labor; $3.02 supplies, including cement and repair parts, sand and gravel being excavated by conservancy forces; power $.37; plant, erection, depreciation and camps, $2.43; industrial insurance and overhead, $.67. The labor cost of $3.51 was divided into thirteen items, of which the principal ones were $.528 for excavating and washing gravel; $.540 for mixing and placing concrete; $.944 for building forms; and $.500 for dismantling and general cleaning up. The work was executed with a force of 95 men, which apparently does not include those employed in excavating and washing the gravel.

Wasteful Refuse Collection

In some notes on refuse collection and disposal by a superintendent in charge of such matters in an English city and published in "Municipal Engineering and Sanitary Record," a peculiarly wasteful practice was narrated as having been observed by him in one of the suburbs of London. He wrote: "To my surprise I found when the day for emptying the dust bin arrived, not one but two horses and carts came to pick up the refuse. While one cart was loaded the second horse and cart trailed along empty behind and was not loaded until the first cart was filled. I expressed my surprise but was told that it was the usual practice, and on occasion three horses and carts were similarly used." He states that he could learn no reason for this and is at a loss to "imagine any possible advantage either in cost or convenience that could be served by such an unusual arrangement."

Skagit River Electric Plant

Seattle interests are taking steps for the development of an enormous hydro-electric plant on the Skagit river, Wash., which drains 3,000 square miles. According to C. S. Uhden, engineer in charge of the work, the city has commenced construction of the first 75,000 h. p. unit of the power that it is estimated will cost about $10,000,000; 48,000 h. p. will be first secured by a temporary crib dam pending the construction of a concrete dam 240 feet high that has involved the building of 26 miles of construction railway at a cost of $1,215,000.

The St. Louis Transit System

Synopsis of a report made by the City Plan Commission, which deals chiefly with re-routing street cars.

The City Plan Commission of St. Louis, after two and a half years of careful study, has submitted to the Board of Public Service a report presenting proposals for the development of the transit lines of the city. This report contains 36 pages and several maps, tables, and diagrams which aid greatly in setting forth the various features of the problem. Two of the diagrams published herewith give an idea of the thought and ingenuity exercised by the commission and its engineer, Harland Bartholemew, in presenting the results of their study of the problem.

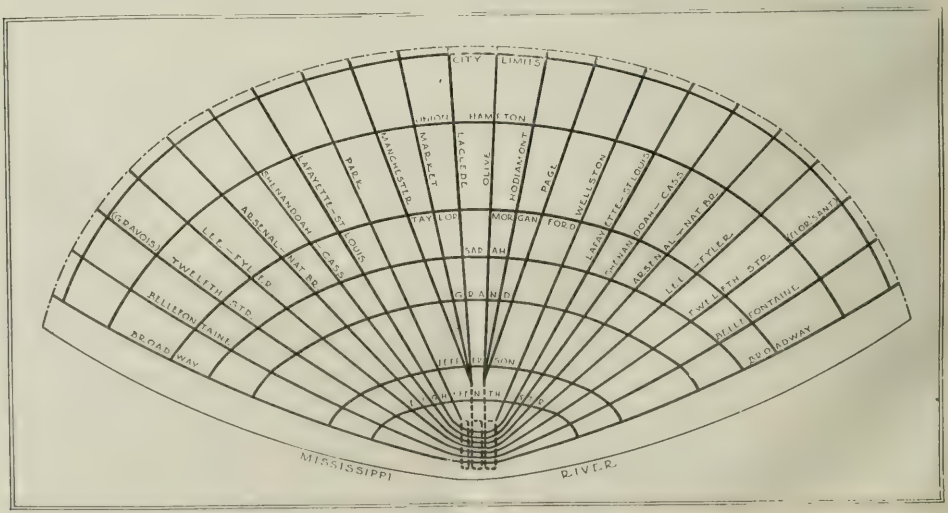
All of the city railway lines in St. Louis are operated by a single company, but there are a number of franchises which require the continuation of operation over certain routes, some of which made efficient and economical operation impracticable. Partly because of this, partly because of over-financing and over-estimate of the growth of the traffic, the operating company went into the hands of a receiver in 1919. The plan submitted looks to the re-routing and re-connecting of the tracks of the various original companies and provision for traffic for the next 10 to 25 years. Included in the plans is the opening, widening and extension of numerous streets which will facilitate more direct routing in some cases.

In studying the present situation the commission compiled statistics of traffic from 1900 to date which show that the total number of passengers was nearly three times as great in 1919 as in 1900. The time required to reach the center of the city over the routes available from the various sections of the city were learned and plotted on a diagram, areas within 10 minutes, 20 minutes, 30 minutes, etc., of the center being indicated by different colors. One small area was found to be 90 minutes from the business center while very considerable areas were 50 and 60 minutes beyond. A companion diagram showing the isochronal zones for the routing proposed by the commission shows very little of the city lying beyond the 40-minute zone and none beyond 60 minutes.

The problems of the immediate future are stated to be relief of the congestion in the business district and more direct routings to all parts of the city. It is believed that by re-routing, the necessities of the city can be met and that rapid transit will not be necessary for the present.

In laying out a plan for re-routing the traffic, it was considered desirable to approximate all routes to a theoretical fan-shaped system, as is shown on the diagram presented herewith. "A feature of the theoretical solution of the transit plan is to gather a majority of the east and west lines into a subway in the business district and so routing north and south lines through the business district as practically to avoid any inter-section of lines, which is one of the present pregnant causes of delay and congestion in the business district." The plan would call for the abandonment of about 8 miles of single track and 7¾ miles of double track, and the construction of 4¼ miles of new single track and 2¼ miles of new double track. Certain extensions of existing lines totaling about 10 miles of new double track lines are proposed also.

The plan provides for two distinct loops, either



THEORETICAL DIAGRAM OF PROPOSED TRANSIT SYST EM FOR ST. LOUIS.
For the other diagram referred to, see cover of last week's issue.

of which may be used for surface car operation or for rapid transit lines. It is estimated that an initial short loop subway for surface car operation would cost $7,000,000; that another loop for rapid transit would cost about $17,000,000, and that a complete rapid transit scheme including the loop and routes to the western, northwestern and southwestern parts of the city, would cost $80,000,000. The rapid transit system designed consists of two distinct parts, one for surface cars in the downtown district and the other for a complete rapid transit system operating entirely by subway or elevated tracks. There would be no contact of the two systems except at stations used in common by the two. It is estimated that the cost of subway construction would be from 5½ to 7 times as great as that of an elevated structure.

The report gives in detail the routes to be followed by each of 19 surface lines as the first step, to be followed with a combination of certain lines and shortening of several of the routes. The commission consists of the presidents of the board of aldermen and board of public service, directors of streets and sewers and of public safety, and the commissioner of parks and recreation, as members ex-officio, together with eight citizens with E. J. Russell as chairman. Frank E. Lawrence, Jr., is secretary. Harland Bartholemew is engineer.

The Georgetown Bridge*

Construction of seven reinforced concrete arches of 85 to 208 feet spans, each with two segmental ribs cast in sections on steel truss centers floated from span to span.

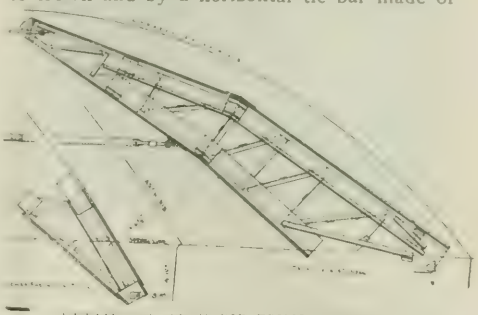
During concreting, the very heavy spans were supported on sets of four massive steel arch trusses, two simultaneously under the center arch rib and later used one under each of the side ribs, so that a total of eight arch trusses sufficed for the simultaneous construction of two spans.

The three-hinge arch trusses, designed and fabricated by the Blaw-Knox Company, were of special construction adapted to serve the different lengths of span by modifications of the end panels, trusses intended for the center or maximum span of 208 feet being reduced to fit the other spans successively by removing members in their end panels.

ARCH-CENTER TRUSSES

Each steel arch-center truss was compossed of two semi-trusses pin-connected at the crown and to the skewback pedestals. For the center span the distance from center to center of skewbacks was 196 feet 6 inches, and the rise between centers of skewback and crown hinge pins was 56 feet 2⅛ inches.

The complete semi-trusses are each approximately lune-shaped, made in six panels with inclined top and bottom chords, the inclination of the top chord being changed at every panel point while that of the bottom chord is changed at only one point. The two semi-trusses are connected at the crown and by a horizontal tie bar made of



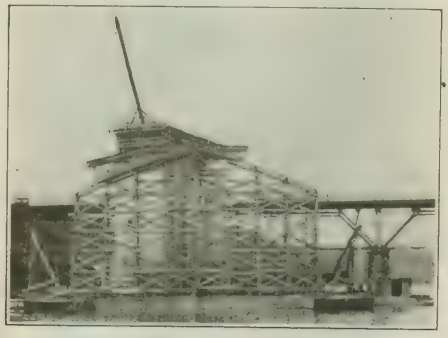
DETAILS OF ARCH RIB TRUSS CENTERS

two angles back to back at an elevation a little below the middle of the lower chord.

The lines connecting the skewback and the crown hinge pin are inclined about 30 degrees to the horizontal. The top chords are slightly divergent from the chords of the intrados of the concrete arch and are distant from them from 1 foot 0½ inches at the haunches to 4 feet 0⅝ inches normally at the skewbacks.

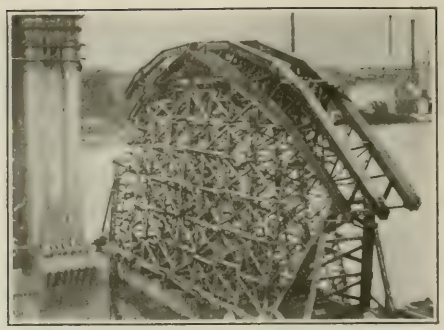
SUCCESSIVE MODIFICATIONS OF TRUSSES

Both the 204-foot and the 208-foot spans are erected with the complete arch trusses. For the erection of the 187-foot spans the short lower end sections of the semi-arch trusses are removed and the pins in the skewback pedestals engage holes in the lower ends of the upper chords of the bottom panels of the trusses. For the 152-foot span the second section is removed from the lower ends of the trusses and for the 85-foot span a third section is removed; the skewback connections in both cases being similarly made through the top chord at the point of its intersection with the lowest remaining web member. These changes, of course, made the semi-trusses still more unsymmetrical but obviated the necessity for any changes in the construction between the skewback and the crown.



ASSEMBLING CROWN SECTIONS OF ARCH TRUSS CENTERS ON FLOATING FALSEWORK WITH PIER DERRICK

*Continued from page 205.



PAIR OF ARCH CENTER TRUSSES NEARLY COMPLETED ON FLOATING FALSEWORK

Both top and bottom chords are compression members with plate and angle trough-shape cross-sections, and the web members are made with pairs of angles connected by tie plates and riveted to the web plates of the chords. The horizontal tension member, 24 feet above the skewback pins in the longest spans, is made of a pair of angles pin-connected at each end to a sleeve-nut rod with a clevis engaging a bent connection plate riveted to the lower chord of the truss. The horizontal member is intermediately supported against sagging by six ¾-inch vertical rods connected to the lower chords of the trusses.

The upper ends of the semi-trusses have steel castings with concave bearings of about 100 degrees for 6-inch crown hinge pins. They are also tied together by horizontal sleeve-nut rods pin-connected to lugs riveted to the trusses. During erection the rods were supplemented by eight ⅞-inch bolts through the hinge castings.

The lower ends of the trusses are secured to the pier by horizontal anchor bolts projecting from the face of the pier, and engaging lugs riveted to the ends of the trusses. This provision enables the trusses to be slightly raised or lowered or moved in either direction longitudinally, to give them close adjustment with the exact position of the arch rib.

ARCH RIB TRUSS CENTERS SUPPORTED ON I BEAM GRILLAGE AND ADJUSTMENT WEDGES AT PIER

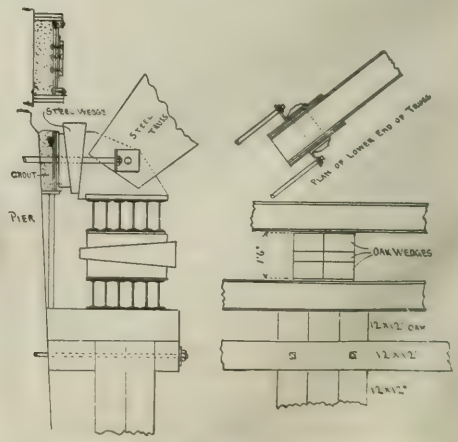
TRUSS SUPPORTS

The ribs are supported by six 12 x 12-inch oak posts at each end of each rib, seated under water on a concrete ledge of the piers, and on top of these are 12 x 12-inch oak caps. There are eight sets of these bolted to each side of the pier, with a steel I-beam grillage on top running full length of the pier.

On the grillage beams and on the center line of the rib there are three oak wedges 2 feet wide and 18 inches high. On the wedges and directly under the shoes are sets of grillage beams long enough to take the two shoes of a pair of ribs. The horizontal thrust is taken by a beveled cast steel wall plate mounted in place against the face of the pier and the adjustment between this and the shoe, by a cast steel wedge. The cast steel wedges were suspended just above the wall plates ready to be dropped in place when wanted.

Garbage Disposal Plant at Middletown

Middletown, Ohio, is about ready to put into service a garbage incinerator which was completed the latter part of February. Meantime the city is considering the matter of collection of garbage and other refuse. Dr. G. D. Lummis, of the Board of Health, has taken an active interest in the matter and recommends that the city itself collect all refuse, claiming that this can be done for 8 cents a year for each property where now the cost is $5.20 per year paid to private parties for removing the refuse. The city commission has decided to turn over the operation of the incinerator to the Board of Health and probably will also adopt the recommendation for municipal collection. It was suggested that the chassis of three or four discarded jitneys be obtained and bodies for refuse collection be purchased from a Cincinnati firm which manufactures them for this purpose, the bodies costing about $900 each.



SUPPORT AND ADJUSTMENTS OF ARCH RIB TRUSS CENTER

PUBLIC WORKS

Published Weekly
by
Municipal Journal and Engineer Inc
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates

United States and Possessions, Mexico and Cuba.... $3.00 per year
All other countries ..... $4.00 per year

Change of Address

Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office Monadnock Block, Chicago

A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

CONTENTS

LINDEN STREET SEWER TUNNEL—Illustrated 217
Good Concreting Records 219
Wasteful Refuse Collection 219
Skagit River Hydro-Electric Plant 219
THE ST. LOUIS TRANSIT SYSTEM—Illustrated 220
THE GEORGETOWN BRIDGE—Illustrated 221
Garbage Disposal at Middletown 222
EDITORIAL NOTES 223
Indefinite Plans and Specifications—Flexibility of Construction Methods and Equipment
New England Road Builders Ask Relief 224
For a Rhode Island Sewerage District 224
PAVEMENT LAID DURING 1920—Table..... 225
HOW MUCH OF BRIDGE SUPERSTRUCTURE IS CLASSIFIED AS HAND RAIL CONCRETE?—Illustrated 227
Water Works Wireless 228
RECENT LEGAL DECISIONS 229
INDEX OF MONTH'S PERIODICALS 15

Indefinite Plans and Specifications

The purpose of plans and specifications is to show amount, character and quality of work, how it should be done and, together with the contract, the price that is to be paid for it. Characteristic differences of method, quality or price should be unmistakably defined. There should be no contradictions in the specifications, plans or contract, or between any two of them, and all essential requirements and prices should be perfectly clear.

Where the work is done on a unit price basis, classifications should be very definite and unmistakable. Nothing in any part of the work should be left vague or indeterminate that can be defined. If it is impossible to determine accurately in advance the governing principles should be stated, and attention called to the manner in which final decisions will be made.

A frequent and inexcusable source of contention is incomplete, careless or unfair classification of work, material and prices. These should be definitely shown in the specifications and provision should be made there for modifying or enlarging the classifications if circumstances or alterations make it necessary.

Two of the most fruitful sources of dispute are classifications and changes in excavation and in concrete work. Especial care should be taken to describe, limit and define these and it is much better to provide too many than too few classifications, especially where the work is at first uncertain or liable to change or development during construction. For the materials in the finished structure there is no excuse for ambiguity in classification. The quantities of each class should be distinctly defined, the class of every member or portion of the work should be stated, the estimated amounts should be given and the classifications should be noted and their divisions marked on the drawings. If this had been done as it should and easily could have been in the work described on page 227 of this issue no controversy would have arisen.

Flexibility of Construction Methods and Equipment

The most efficient and economical results in construction work are generally obtained by the most judicious use of standard methods and equipment supplemented in an emergency or unusual conditions by new devices or by ingenuities developing special resources or avoiding special dangers. The engineer and contractor who is most familiar with standard practice and has the ability to modify it to the best advantage is likely to secure much the best results.

An excellent illustration of this is found in the Georgetown bridge, described in this issue, where long concrete arch spans have been built safely over a somewhat dangerous channel on steel false work trusses simply adjusted to different lengths and handled on movable false work. They were assembled on floating false work, itself of a special character designed to distribute the load on a plurality of barges forming an easily movable and somewhat flexible support. They were transferred from span to span supported on the same false work.

Special provision was made for the rapid and accurate adjustment of the centers by means of pairs of wedges in vertical and horizontal planes, which also insured the expeditious striking of centers after the arch concrete was set.

In order to mix and distribute a large quantity of concrete at a considerable range of elevations in a long line, three separate plants were provided commanding the entire work and securing special concentration at required points.

The foundations for the river piers were built in the dry, in cofferdams of special design and efficient construction which were so arranged that the framework and bracing were advantageously completed on shore, sunk to position and then enclosed by unusually strong and efficient sheet piles of a special type designed to utilize for preliminary service the structural steel afterwards forming part of the permanent floor system and thus avoiding a considerable expense for steel sheet piles that would otherwise have been used for the work.

New England Road Builders Ask Relief

The Executive Board of the New England Road Builders' Association has recently prepared a number of important requests and recommendations concerning highway construction in Massachusetts which have been submitted to and discussed with the commissioners of the Highway Division of Massachusetts. They are intended to afford immediate relief to contractors on state work from burdens arising from the unnecessary retention of money by the state and from increased costs that could not be foreseen, and to secure some improvements in the character and details of specifications for highway work.

The principal requests are for:

1. The immediate payment of money unnecessarily retained by the state.
2. Reimbursement of increased cost occasioned by advance of freight rates unforeseen at the time contracts were awarded.
3. Extra allowance on account of increased labor costs that could not be foreseen.
4. Reduction of reserved percentage.
5. Acceptance of the work in sections.
6. Payments on materials delivered or stored for the work.
7. Investigation and approval of materials previous to advertising for bids.
8. Changes in specifications including increased allowance for overhaul; classification of excavation into five classes; uniform method of placing stone fill; payment for removal of trees; payment for extra work.
9. Bi-monthly estimates.
10. Measurements of roadway excavation.
11. Filing plans and other information at District Engineer's office.
12. Provision in advance of methods of providing for travel and detours previous to invitations for bids.
13. Modification of unit prices to correspond with changes of quality or quantity.
14. Authorization of engineers to adjust claims for delays and reimbursements.
15. Classification of unit price work and provision to contractors of information concerning the work when bids are invited.

Replying to the above petition the Massachusetts Department of Public Works has replied to the New England Road Builders' Association, in part:

No change will be made in the present contract requiring a 15 per cent retained percentage. Agreement will, however be made to provide for reducing the percentage of retained percentage on such portion of a contract as may be completed so as to allow use of the same by the public, to 5 per cent of the estimated value of that particular portion of the work. A retained percentage of 15 per cent will apply to other work on the uncompleted portion of contract that may go over the winter season.

Payments on materials delivered or stored for the work.

The Commissioners will consider requests under this section, each case on its own merits, but no consideration will be given to requests for payment on perishable material.

Investigation and approval of material previous to advertising for goods.

The Commissioners will provide that all engineers and officials of the Department will furnish all possible information to aid contractors in having as full an understanding of conditions associated with each contract as it is possible to secure, but no guaranty as to conditions will be made by the Department or any official acting for the Department.

Recommendations for changes in the specifications for State Highway work.

a. Increased allowance for overhaul.

Specifications are now being printed with a change so that one cent will be allowed for overhaul instead of one-half cent as in the past. No change in other conditions referred to overhaul.

b. Classifications of excavation.

Specifications are now being changed so that ledge excavation will include removal of all stones in stone culverts.

c. Payment for removal of trees, etc.

There will be no change made in the specifications, but where there are a large number of trees of substantial size, a special rider will be included in specifications relative to the removal of such trees and stumps.

d. Payment on extra work.

The Commissioners will agree to provide in the specifications, in connection with payment on extra work, provision to include expense of workingmen's compensation insurance, public liability insurance and the contractor's bond.

"Bi-monthly estimates."

We assume you mean semi-monthly estimates, and these will be continued during the coming year.

Plans and other information should be on file at district engineer's office.

Arrangements will be made to have accessible to contractors at the offices of different district engineers, where the work may be proposed, a complete set of plans and such information as the Department possesses relating thereto.

Decision on method of providing for travel previous to calling for bids.

The Commissioners will comply with this request wherever possible.

Requests not enumerated above were not granted.

For a Rhode Island Sewerage District

Providence, Rhode Island, is now discussing the formation of a metropolitan sewerage district embracing the cities of Providence, Pawtucket, Central Falls, Cranston and Woonsocket, and the towns of East Providence, Cumberland, Lincoln and North Providence, all of which discharge sewage into Naragasett Bay and the streams discharging into it. Some form of co-operation between these several municipalities would seem to be necessary to the success of any effective plant for purifying Providence harbor and the bay beyond. Although industrial corporations are responsible for a good deal of the oil and other filth reaching the harbor, cities and towns contribute the most dangerous, if not the most offensive portions of it. A bill has been introduced in the House for creating a sewerage district of the cities named, the commission in charge of the same to be composed of the mayors and the presidents of the cities and towns.

As we have stated a number of times, it is unfortunate that in all cases sewerage and water works problems could not be worked out on the basis of geographical and topographical boundaries, rather than wholly in accordance with political ones as is the almost universal practice. Could this plan be generally followed in the original inception of such systems rather than delayed until necessities of sanitation make co-operation necessary, much expense could be saved to all concerned in many instances.

PAVEMENT LAID DURING 1920

City and State	Sheet Asphalt	Asphalt Concrete	Tar Concrete	Bitulithic	Bitoslag	Rock Asphalt	Wilkinson	Asphalt Macadam	Tar Macadam
Alabama:									
Birmingham				6,[illegible]					
Ensley				75,404					
Sheffield				40,112					
Arizona:									
Douglas		38,000						[illegible],000	
Mesa									
Phoenix				11,732					
Prescott				137,106					
Tempe				17,625 8					
Yuma				28,937					
California				18,268					
Chico									
Chula Vista				200,000					
Dinuba				60,905					
Dixon				44,437					
Eureka				68,482					
Fresno				75,363					
Fowler				192,636					
Gridley				7,426					
Hanford				65,179					
Holtville				193,161					
Lodi				58,690					
Los Angeles	136,055	5,510		17,651					
Martinez				51,721					
Marysville				80,358					
Modesto				18,254					
Oxnard				88,663					
Pasadena	62,000§			110,994				44,473	
Reedley									
Sacramento				62,661					
Sanger				26,551					
San Diego				38,281					
Santa Barbara				79,337					
Selma				45,716					
Stockton				66,234					
Turlock				15,786					
Ventura				53,206					
Woodland				34,962					
Yuba City				55,989					
Colorado:				4,299					
Ft. Morgan									
Connecticut:				45,335					
Bridgeport									
Shelton	700c			159,205					
Stamford									
Florida:									12,000
Daytona Beach				27,057					
Georgia:									
Augusta		4							
Idaho:									
Blackfoot				11,129					
Buhl				40,970					
Caldwell				46,340					
Coeur d'Alene				14,291					
Pocatello				91,684					
Preston				37,973					
Twin Falls				291,597					
Illinois:									
Chicago	25.80	.02						10.53	
Chicago Heights		37,000							
Moline		11,780							
Oak Park	12,740	35,653							
Indiana:									
Evansville	115,071.02								
Kokomo	37,857.5								
Wabash	28,000								
Iowa:									
Centerville				10,434					
Des Moines				17,841					
Dubuque				28,760					
Jefferson				37,198					
Newton				40,318					
Parkersburg				22,361					
Tama				20,905					
Kansas:									
Kansas City		10,700				66,000			
Louisiana:									
Alexandria				775					
New Iberia				11,984					
New Orleans				95,158					
Maine:									
Lewiston									21,000
Waterville								6,000	1,200
Maryland:									
Frederick		400						4,500	
Massachusetts:									
Cambridge				32,200					
Chelsea				9,463					
Fall River				74,110					
Framingham								425	13,300
Lawrence								60,300	
Lowell									9,895
Malden									5,000
Medford									3,757
Needham								10,000	
New Bedford				82,286					
Newton								26,809	21,703
Newtonville				462					
Scituate				512					
Webster								2,200	
Michigan:									
Battle Creek	28,215								
Saginaw	10,000								

PAVEMENTS LAID DURING 1920 Continued

City and State	Sheet Asphalt	Asphalt Concrete	Tar Concrete	Warrenite-Bitulithic*	Bitoslag	Rock Asphalt	Willite	Asphalt Macadam	Tar Macadam
Minnesota:									
Alexandria				32,848					
Bemidji				37,179					6,500
Chisholm									
Duluth				23,888					
Eveleth				20,677					
Fairmont				24,460					
Hopkins				9,915					
Litchfield				38,062					
Marshall				41,029					
Virginia				7,734					
White				12,840					
Worthington				30,796					
Mississippi:									
Corinth				12,638				10,000	
Greenwood		30,000							
Pascagoula				26,224					
Missouri:									7,500
Brookfield								11,320	
Jefferson City									
St. Louis	162,289	2,289		70,578				1,878	
Montana:									
Roundup				11,294					
Nebraska:									
Columbus				64,859					
Cozad				27,887					
Nebraska City		28,000							
Ord				31,069					
New Jersey:									
Asbury Park				5,944					
East Orange				64,169					
Harrison				6,943					
Irvington				5,590					
Kearny				11,777					
Orange				69,213					
Paterson	51,602	1,854			3,678	8,467		3,347	
Perth Amboy				33,520					
Roselle Park		119							
West New York				14,000					
New Mexico:									
Albuquerque				101,318					
Las Vegas				28,196					
East Las Vegas				23,105					
Poughkeepsie								1,028	
Raton				13,876					
New York:									
Albany	15,350	5,600							
Auburn				14,000					
Cohoes				8,021					
Gloversville				10,132					
Hempstead				4,355					
New Rochelle				18,140					
North Hempstead				5,700					
North Tonowanda				10,130					
Richmond	8,944	15,367						34,584	
Syracuse	4,38								
Tonawanda				7,366					
Troy				11,414					
Utica		1,215 S		17,362					
North Carolina:									
Asheville	2,781	350							
High Point				14,954					
Salisbury				55,891					
Winston-Salem				66,568					
North Dakota:									
Devils Lake				70,000					
Fargo				50,000					
Jamestown				53,167					
Wahpeton				15,175					
Ohio:									
Cleveland				48,092					
Garfield Heights				13,343					
Hillsboro				15,123					
Norwood				5,861					
Toledo	86,636	41,705							
Washington CH.	45,073								
Oklahoma:									
Miami				131,020					
Oregon:									
Athena				17,137					
The Dalles				39,448					
Enterprise				71,718					
Forest Grove				36,718					
Freewater				13,329					
Hillsboro				2,887					
Klamath Falls				25,110					
Milton				33,589					
Ontario				48,015					
Pendleton				12,976					
Portland		12,00							
St. Helens				5,084					
Pennsylvania:									
Erie	137,000								207
Hazleton									8,89
Philadelphia	22,80								
Pittsburgh	60,600			29,400					
Sayre									
Summit Hill									9,740
Wilkes Barre	20,968								
Rhode Island:								24,314	
Newport								87,867	
Pawtucket									

*Most of the figures in this column were furnished by Warren Brothers Co. S Square feet. C Dollars.

Construction Questions Answered

How Much of Bridge Superstructure is Classified as Hand Rail Concrete?

Should be clearly defined in plans and specifications. If indeterminate, may be fixed by method of construction, by function, by proportions of concrete, by cost of construction, by current practice, by precedent or by mutual agreement.

Montana, January 24, 1921.

Editor, PUBLIC WORKS.

Dear Sir:

Under "Construction Questions Answered" may I impose on your good nature for advice. I am enclosing detail of hand rail on the bridge I am now constructing. The contract price of class "A" concrete per cubic yard is a certain amount, and the concrete in the hand rail is a certain price.

What I desire is the opinion of some engineer or organization as to what is the intersection between the railing concrete and the floor slab so that I may determine the basis on which I should receive pay for the railing concrete, as it is much more expensive than the floor slabs. Would all concrete above the floor slab be considered railing concrete?

If I have not made myself plain, I should be pleased to furnish you further information.

If this information can be furnished me, I shall be glad to pay any expense that may be incurred.

Thanking you for any courtesies shown, I am,

Very truly yours,
GENERAL CONTRACTOR.

(Your inquiry is welcome, as are all concerning any phase of construction interests, whether of conditions, requirements, methods, equipment, precedent, efficiency, alternatives, difficulties or successes. If we have not the necessary information at hand it is easy to confer with friends who do have it, or to consult authorities and references that are more accessible here than in some remote places or to people unfamiliar with them. In any event, there is never any question of cost to the inquirer and we do not wish anyone to hesitate to ask any bona fide question.)

Your letter and the accompanying blueprint do not give sufficient information for a decisive determination of the amount of concrete to be included in the hand rail classification.

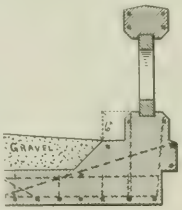
The simple contract provision that the concrete in the railing shall be paid for at a certain price per cubic yard and that class "A" concrete shall be paid for at another price, is not sufficient without definition in the specifications or additional instructions, or data on the drawings. In the absence of these, the decision is likely to be arbitrary and to be influenced very much by the fairmindedness, or the reverse, of the engineer.

Without additional information or restrictions it is an illustration of the unfortunate class of vague, contradictory or indeterminate specifications (including plans) that are a fruitful source of dispute, litigation and general delay and loss, for which there is no excuse. Of course if both contractor and engineer are broad-gauge, fairminded, practical men, the question can easily be decided on its merits, and the same classification and payment be secured as should be if it had been provided for in advance.

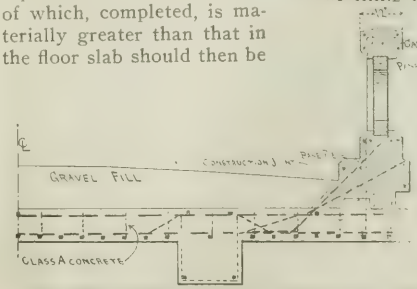
The given data are so inadequate that any decision made on them or any precedent of similar work would have little value for comparison, and the decision becomes largely a personal or local one. It should, therefore, be decided solely on its merits and the current practice, if any, of the same engineer and contractor for the same class of structures in the immediate vicinity, if any such cases exist.

The specifications should have provided that the floor slabs shall be composed of class "A" concrete of the given proportions and the contract, if for unit prices, should give the price per yard of class "A" concrete wherever it is placed. The specifications should define the hand rail as consisting of vertical posts, top rail, intermediate panels or balusters, and bottom rail or base piece (if the latter is necessary to the construction of the hand rail), all made of concrete class "C" of given proportions or of class "C" and "D" and "E" of the required proportions and prices. The members included in the hand rails should also be specifically marked on the drawings, in which case no controversy could arise.

In the absence of these specifications, definitions, classifications, your letter itself affords the basis of a just determination in that "you should receive pay for the railing concrete as it is much more expensive than the floor slabs." That portion of the concrete above the top of the floor slab, the cost of which, completed, is materially greater than that in the floor slab should then be



ORIGINAL DESIGN OF HAND RAIL



REVISED CROSS SECTION OF HAND RAIL AND FLOOR SLAB

all classified as "hand rail concrete," and paid for at that govening unit price.

Judging from the cross-section, the only question is whether the base piece engaging a longitudinal rib on the upper surface of the floor slab and itself recessed to receive the lower edge of the balusters or intermediate panels, be classified as class "A" concrete or as hand rail concrete.

If its mix is of the same proportion as that in the floor slabs, if the form work and placing are not much more costly than ordinary wooden form work in other parts of the structure that are classified as "A" concrete, it should be so classified, especially as it is closely structurally related to the slabs by reason of the bonding together with the long bent ends of reinforcement bars projecting from the floor slabs.

If, on the contrary, the concrete in this member is of a different mix from that in class "A," if it is more expensive to make and to place, or if it is finished in the same manner as that of the upper part of the hand rail and different from that of the floor slabs, it should be classed as hand rail concrete.

The assumptions made by you in preparing your estimate for the bid, or your own practice and that of the engineer on previous work of a similar nature, or the usual practice in your locality for such work, if any has been done before, should all be considered, and if these are contradictory, a just settlement should be secured by compromise based on the actual cost of constructing this part of the work.

Since the above was prepared, the following letters on the subject have been received and sent:

Dear Sir:

In reply to your letter of February 8, beg to state as follows:

I enclose herewith original blueprint of hand rail, also revised section. In estimating the labor for the forms on the hand rail, as shown in the original plans, in my judgment the plane of separation would be the point of gravel fill, leaving about 8 inches for a base on the hand rail. It would be very easy to set the forms for the same, assuming that point to be the plane of separation between class A and hand rail concrete.

The revised sheet distinctly shows the plane of separation to be the top of the floor slab line, which makes a very expensive form to make and set. My point is that owing to the change in the plans the plane of separation should be as shown on the revised sheet and all concrete above should be classified as rail concrete at the rail concrete price.

The engineer wants to make the plane of separation 6 inches above the gravel fill, leaving an 8-inch base, and classify between floor slab and base class A concrete. In the original estimate the approximate quantity of hand rail concrete was 43 yards and as everything was approximate quantities, this matter never came up until we began to place the hand rail concrete.

I trust I have made myself reasonably clear, but if not, will you advise me and I will answer whatever questions you make. There are no local decisions of which we know, as this is the second largest bridge in the state, and the matter has apparently not been litigated here.

I appreciate your courtesy in this connection, and will be very interested to hear from you again.

Very truly yours,

General Contractor.

In view of the additional facts disclosed in your favor of February 23, responsive to our reply of February 8, it appears that if the lower part of the hand rail was actually constructed at the same time and with the same mix of concrete as the floor slab, and if a single form was used both for the floor slab and the lower part of the hand rail, the engineer's ruling is correct and only that portion of the base piece that is more than 6 inches above the top of the gravel fill is entitled to be classified as "hand rail concrete."

This classification corresponds substantially with the classification that you anticipated on the original design and apparently the difficulties of construction are not much increased above those of the original design, since the only material changes are making the base piece 6 inches higher and adding another reinforcement bar, which only involve larger dimensions and one more shoulder in the cross section and should make but little difference in the method or cost, although that little difference is to increase the cost. Such an increase is, however, well within the ordinary requirements of this class of construction.

If, on the other hand, the hand rail as shown in the revised cross section was actually made with the construction joint between it and the floor slab and was made after the floor slab was completed, using an entirely different and additional form that cost much more than the floor slab forms and the change was necessitated by the revision of the original plan on which you bid, the whole of the base piece down to the construction joint between it and the floor slab is entitled to be classified as hand rail concrete.

If in the revised plan the engineer had omitted the construction joint between the floor slab and the base piece and had also omitted the lower shoulder 6 inches high on the inner face of the base piece, just above the inclined surface, the cost of construction would have been little more than the original design and his allowance of only 6 inches in height for the hand rail base piece would be reasonable.

From the fact that he introduced another offset in the concrete and clearly designated a construction joint between the base piece and the floor slab it is fair to assume that he considered the revised higher base piece more difficult to construct than the original one and provided for its separate construction as an independent unit, which, forming part of the hand rail, is thus provided with an obvious limitation and should all be classified as hand rail down to the construction joint with the floor slab. The deliberate change in the drawing therefore strengthens your claim for classification which should be allowed.

Water Works Wireless

The water commission of Denver has installed wireless stations by which it communicates from Denver with the superintendent of the Cheesman dam 60 miles away and the head waters of the South Platt river. One of the employees of the water board in its engineering office who has made a study of wireless telegraphy installed the station at the dam. During 1920 the messages were sent and received in Denver at the Y. M. C. A. wireless station, but the commission expects to establish a station in its own offices this year.

Recent Legal Decisions

SUB-CONTRACTOR'S EXCAVATION CONTRACT CONSTRUED

A sub-contract for canal excavation for a government project not only referred to the plans and specifications in the original contract, but required the work to be done pursuant to the direction of the government engineers. The contractor was not required by his contract to complete omitted embankments left for subsequent structures. The Circuit Court of Appeals, Ninth Circuit, United States v. Pearson, 267 Fed. 814, holds that the sub-contractor was not required to return and excavate portions of the canal left by direction of the engineers to furnish dirt to fill the embankments over structures completed after the original excavation was made.

RESOLUTION OF INTENTION TO IMPROVE STREETS MUST BE PROPERLY PASSED

The Montana Supreme Court holds, Hinzeman v. City of Deer Lodge, 193 Pac. 395, that a resolution of intention, in due form and properly adopted, is the fundamental basis upon which all further proceedings to improve a street must stand. It is the essential thing which clothes the city authorities with jurisdiction to proceed with the proposed improvements. The very meaning of the word "jurisdiction" is power to hear and determine; and if no resolution of intention was passed, substantially as the statute provides, no power exists in the municipal authorities to let the contract or take any of the various steps necessary to create a valid improvement district. Therefore a resolution of intention to create a special improvement district was held not "passed" within the meaning of Montana Laws, 1915, c. 142, where not signed by the mayor until after publication, in view of Rev. Codes, par. 3205.

POSSIBLE NUISANCE BY SEWER HELD TOO REMOTE TO INVALIDATE TAX BILLS

In a suit against a city to declare certain district sewer tax bills void, the point was raised that the district sewer in question did not comply with the law in that it did not connect "with a public sewer or other district sewer or with the natural course of drainage" as required by the city charter. It was shown that, years before this district sewer was built, there had been constructed at public expense a sewer which had become known as the "lost sewer" or "dry tunnel." It was also shown that the mouth of this lost sewer did not empty into a natural drainage and that the flow from its mouth would spread out on the ground and become a nuisance to the surrounding neighborhood. It was also shown that the district sewer for which these tax bills were issued connected with this "lost sewer," and that all inflow into the former would be carried clear beyond the special district and to the mouth of the "lost sewer." The question was: Could the plaintiff complain when his district sewer did connect with this "lost sewer" (it being a tunnel erected by the city as a public sewer) merely because the city had not taken the proper precaution to dispose of the waste at its mouth? The Springfield (Mo.) Court of Appeals, Deming v. City of Springfield, 224 S. W. 1004, holds that he could not, the fact that nuisance will be created at the outlet of the "lost sewer" being too remote.

INJURIES BY DEFECTIVE SPOUTS CAUSING ICY SIDEWALKS—INDEMNITY RECOVERABLE BY CITY FROM PROPERTY OWNER

The Springfield (Mo.) Court of Appeals holds, City of Springfield v. Clement, 225 S. W. 120, that where an abutting owner negligently permits the down spouts and cornice on his building to remain in a defective and leaky condition, causing a formation of rough and uneven ice and snow on a sidewalk, resulting in injury to a pedestrian, he is liable therefor. Where a judgment has been rendered against the city for the injury because of constructive negligence in permitting the sidewalk to become and remain in a dangerous condition, the city may recover the amount of the judgment from the owner in an action for indemnity, the owner not having been made a party to the action by the pedestrian.

IMPLIED DEDICATION AND ACCEPTANCE OF STREET NOT PROVEN

The West Virginia Court of Appeals holds, Miller v. City of Bluefield, 104 S. E. 547, that if an isolated and equivocal act done upon a piece of land by the public authorities, such as grading one end of it, fronting on a street, so as to make it accessible from the street, as if it were an alley, can be regarded as an attempt on the part of the public authorities to assume control thereof for public purposes, their failure to continue to perform acts upon it significant of public dominion and control, amounts to an abandonment of the attempt, and in such case there is neither sufficient public use and control nor acquiescence on the part of the owner to make out a case of implied dedication and acceptance.

CITY NOT LIABLE FOR OVERFLOW OF LAND NOT APPROXIMATELY CAUSED BY IT

In a suit to enjoin a city from causing water to be drained from a highway upon the plaintiff's land and for damages it appeared that the acts of the city complained of, in constructing a catchbasin and laying a 12-inch pipe therefrom onto adjacent land were not the proximate efficient cause of the surface water overflowing the plaintiff's land, but that the digging of a ditch on and from the adjacent land by the owner thereof, together with the smallness of a 6-inch pipe which was not laid by the city and for which it was not responsible, caused the plaintiff's land to be overflowed. The Massachusetts Supreme Court, Blair v. City of Brockton, 128 N. E. 941, held the city was not liable for the injuries therefrom.

NEWS OF THE SOCIETIES

March 11—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Engineering Societies Building, New York City.

March 14—CLEVELAND SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Joint meeting with Association of Iron and Steel Electrical Engineers.

March 14 — AMERICAN RAILWAY SIGNAL ASSOCIATION. Congress Hotel, Chicago.

March 14—WATERBURY, CONN., SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

March 14—AMERICAN ASSOCIATION OF ENGINEERS. The third annual railroad conference. Chicago.

March 14-15 — FEDERAL VALUATION OF RAILROADS. Congress Hotel, Chicago.

March 14-16—INDIANA SOCIETY OF SANITARY ENGINEERS. Muncie, Ind.

March 15-17 — AMERICAN RAILWAY ENGINEERING ASSOCIATION. Chicago.

March 17—BRIDGEPORT, CONN., SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Chamber of Commerce.

March 18—DETROIT-ANN ARBOR SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Joint meeting with Detroit Engineering Society.

March 18—SCHENECTADY SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

March 20—VANCOUVER SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Joint meeting with B. C. Technical Association.

March 22—PHILADELPHIA, PA., SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Engineer's Club.

March 22—ATLANTA, GA., SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Carnegie Library, Atlanta.

March 22—BALTIMORE, MD., SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Engineers' Club.

March 23-24—AMERICAN WATER WORKS ASSOCIATION. Illinois Section. Annual meeting, Chicago, C. C. Habermeyer, Secretary, Urbana, Ill.

March 25 — KANSAS CITY SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Northeast Power House of Kansas City Light & Power Co.,

March 25—SAN FRANCISCO SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Substation of United R. R. of San Francisco.

March 25—COLORADO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Metropole Hotel, Denver.

March 25—METROPOLITAN SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Engineering Society Building, New York City.

March 30—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Directors' meeting. Atlanta, Ga. Secretary, James T. Mulcahey, Yonkers, N. Y.

April 1 — VANCOUVER SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

April 11 — HARTFORD SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. City Club, Hartford Conn.

April 15—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Joint meeting with the Association of Iron and Steel Electrical Engineers. Pittsburgh, Pa.

April 18-23 — UNITED STATES GOOD ROADS ASSOCIATION. Greensboro, N. C.

April 21-22—BANKHEAD NATIONAL HIGHWAY ASSOCIATION. 5th annual convention. Greensboro, N. C. Secretary, J. A. Boutree, Birmingham, Ala.

April 22—BIRMINGHAM SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with Atlanta, Birmingham and New Orleans sections, with members of Council present. Battle House, Mobile, Ala.

April 27—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention. Houston, Texas.

April 27-29—UNITED STATES CHAMBER OF COMMERCE. 9th annual meetin Atlantic City, N. J.

April 27-29 — BUILDING OFFICIALS CONFERENCE. Seventh annual meeting, Cleveland, Ohio.

April 28-29—MID-CONTINENT SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting of Chemical Eng. Societies. City Auditorium or Convention Hall, Tulsa, Okla.

April 29 — COLORADO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Metropole Hotel.

May 2-4—MISSISSIPPI VALLEY ASSOCIATION. 3d annual convention. New Orleans, La.

TRADE CONVENTION. 8th conven-

May 4-7 — NATIONAL FOREIGN tion. Cleveland, Ohio.

May 9-11 AMERICAN ASSOCIATION OF ENGINEERS. 7th annual convention. Buffalo.

May 9-12—SOUNTHWEST WATER WORKS ASSOCIATION. Shirvin Hotel Headquarters, Oklahoma City, Okla.

May 9-12 — SOUTH-WEST WATER WORKS ASSOCIATION. Oklahoma City. Headquarters Skirvin Hotel.

May 17-19—NATIONAL FIREMEN'S ASSOCIATION. Twenty-third annual convention. Fort Wayne .Ind.

May 20 — AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. 370th meeting. Engineering Societies Building, New York City.

June—CONFERENCE OF MAYORS AND OTHER CITY OFFICIALS. State of N. Y. 12th Annual Conference. Elmira, N. Y.

June 6-10—AMERICAN WATER TER WORKS ASSOCIATION. Annual convention at Cleveland, Ohio. Secretary, J. M. Diven, 153 West 71st St New York.

June 7-9—NATIONAL FIRE PROTECTION ASSOCIATION. Annual meeting. San Francisco, Cal

June 21-24 — AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual and Pacific Coast Convention. Salt Lake City.

AMERICAN ASSSOCIATION OF ENGINEERS

The third annual railroad conference will be held at the Congress Hotel, Chicago, March 14, and includes for the first time Canadian railroads. The main subject of this meeting is to develop cooperation between employers, employees and the public. The annual exhibition of the National Railway Appliances Association in the Coliseum will be open March 14 to 17, inclusive, from 8 a. m. to 6:30 p. m., except Tuesday, March 15, when the exhibition will close at 11 p. m. Practically every device used in the construction, maintenance and operation of railroads will be on exhibition. The program of the third annual railroad conference is tentatively outlined:

10 a. m. One Minute Reports from Railroad Section's official delegates.

"Effects of U. S. Railroad Labor Board's Decision on the Salaries of Railroad Professional Engineers," J. D. Trueblood, Asst. Engineer, C. & N. W. R. R. Discussion, led by Major W. A. Hill, President, C. B. & Q., E. Section; J. R. Barclay, Secretary, P. & L. E. Section; Hardy Byran, Vice-President, No. Pac. Section.

"The Railroad Department of A. A. E. in 1920," E. L. Brandt, Assistant Secretary in charge of Railroad Department. Discussion, led by C. I. Long, Chief Draftsman, N. Y. C. Lines West; C. O. Axell, Chicago & Alton Section; W. S. P. Robins, Secretary, K. C. T. Section.

Management," Professor Lewis Gustafson, Superintendent, David Rankin, Jr., School of Mechanical Trades; "Educational Plan Now in Effect," W. L. Lewis, President, G. N. Section. Discussion, led by V. L. Nelson, Secretary, T. & O. C. Section; P. D. Miller, Asst. Div. Engr. Pa. System; W. B. James, President, M. C. Section; Lem Adams, U. P. Section.

"Railroad Occupational Classification." Discussion, led by W. C. Bolin, Pilot Engineer, B. & O. R. R.; R. H. Kerr, President, K. C. T. Section; R. G. Aylsworth, Asst. Engr., C. B. & Q. Lines, West Section.

Report of National Railroad Council Sub-Committee on Revision of Salary Schedule, and discussion.

8 p. m. "A. A. E.—Its Beginning and Past," W. H. Finley, President, C. & N. W. Railway, Past President, A. A. E.

"A. A. E.—Its Present and Future," L. K. Sherman, President, A. A. E.

Address upon some big problems affecting the railroads, by a speaker of note.

BUILDING OFFICIALS' CONFERENCE

The seventh annual meeting of the Building Officials' Conference will be held in Cleveland, Ohio, April 27-29.

Meeting Wednesday, April 27, at the Hotel Statler at 10 a. m.; joint session with the Hollow Building Tile Association, and address by Charles C. Crockatt on "Hollow Building Tile and Its Relation to Building Laws and the Administration of Those Laws."

An address followed by discussion on the subject of "Standard Classification of Buildings as to Occupancy."

A visit to terra cotta plants in the vicinity of Cleveland, with members of the Hollow Building Tile Association, and a trip of inspection of a new type of eight-inch brick wall construction—at the invitation and suggestion of the Common Brick Manufacturers' Association.

April 28, business meeting. Afternoon session. Address by Dr. Robert H. Whitten, special city plan advisor for the City Plan Commission of Cleveland, on "Building Zones." Address by William Carver, of the Common Brick Manufacturers' Association, on "The Thickness of Brick Walls for Small Residence Buildings." A discussion on "Methods of Inspection." A discussion on "Signs and Other Projections in Public ways." Discussion on other topics of interest. April 29, trip to Massillon, O., to visit the plant of the National Pressed Steel Co. Buildings in construction of which metal lumber is being used will be visited. There will be a discussion on the use of metal lumber as a building material.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

AUSTIN-WESTERN ROAD MACHINERY

Catalog No. 20 of the Austin-Western Road Machinery Company is a sort of summary of twenty-six special catalogs of Western machines including reversible road machines, road planers, planer attachment, road drags, wheelers and scrapers, grading and rooting plows, elevating graders and dump wagons, rock crushers and crushing plants, portable gravel screening plants, scarifiers, dump cars, reversible road machines, motor road rollers, steam road rollers, tandem rollers, road scarifiers, roller scarifiers, grader scarifiers, motor sweepers, street sweepers, sprinkler sweepers, water sprinklers, pressure road oilers, gyratory rock crushers and crushing plants, elevating graders and dump and spreader wagons.

The number and variety of these machines is so great that one is to be found for any specified step of road and street building and maintenance. The list has grown from the first wheel scraper made by the Western Wheel Scraper Company more than fifty years ago to a line of Austin road rollers, both motor and steam made, in macadam and tandem types. The Western line of reversible graders embraces machines varying from 1,000 pounds to 9,000 pounds in weight, the smallest being easily operated by one man and two horses, while the largest is guaranteed to stand the strain of the most powerful traction engine. The advantages include an even cut, a floating, reversible scraper blade and ease of operation.

The Western scarifier is very strong and is successfully used in mountainous country and in hard boulder soil. The Austin Road Ripper is a massive scarifier attached for use on the mammouth senior or junior graders and when hauled by a tractor can tear up road surface at the rate of from ½ mile to 2 miles per day.

ROAD SCARIFIERS

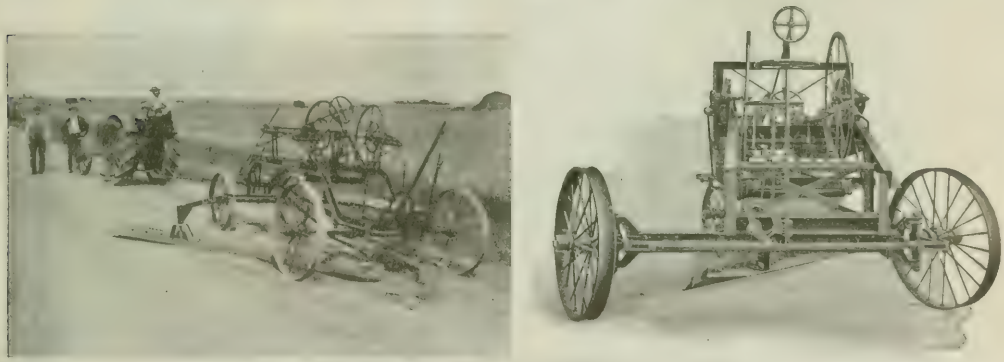
The Western road planer and finisher will resurface an entire roadway from ditch to ditch in one trip, leaving a uniformly plowed grade with a smoothly rolled, compact and perfectly finished center. Western road drags weigh 315 pounds, have blades 8 feet long and are heavily braced.

The Western-Aurora crushers and folding elevators have capacities of 9 to 25 tons of 2-inch rock per hour and require from 8 to 20 h. p. Portable bins and revolving screens are provided to go with them. Portable gravel and screening plants are also designed to be driven from the crusher. Stationary and revolving gyratory crushers have a capacity of 500 to 600 tons of rock per hour to a diameter of 2¼ to 5 inches.

The Austin single cylinder kerosene motor rollers are built in sizes of 7, 8, 10, 12 and 15 tons and can be fitted with a pneumatic scarifier attachment. The Austin tandem motor roller is built in 5, 6, 7 and 8-ton sizes.

The Austin motor sweeper is made with a dipper cleaning attachment. The Austin street sweeper is recommended for cleaning streets and roads before they are oiled. The Austin combination sprinkler-sweeper is suitable when the work to be done does not justify the purchase of an expensive equipment. The Austin street sprinklers and pressure road oilers are each operated by one man.

The Western elevating grader is built in three sizes with a capacity of 1,000 cubic yards per day and upward under favorable conditions. Many varieties of dump wagons, scrapers and plows are also listed. Brief descriptions are given of them and they are illustrated by general views intended to be supplementary to complete details and specifications given in numerous special catalogs.



ROAD SCRAPING, DRAGING AND FINISHING MACHINES

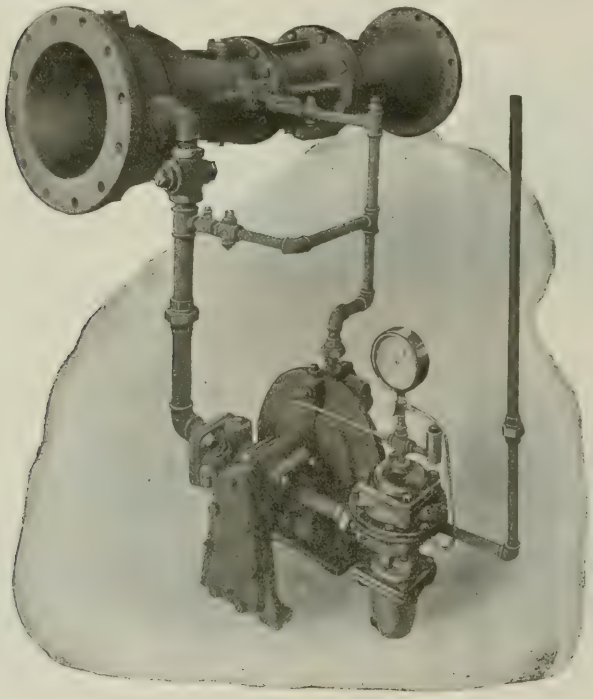
PAVING GUARDS

Paving guards for street railways and roadways are manufactured by the H. U. Boreau & Company and are designed to protect the adjacent roadway from damage by rail movement and displacement and from the action of water, impact, disintegration and displacement of the pavement and its foundation.

Their use is an economy in maintenance and permits the removal or adjustment of the track rails without delay or injury to the paved surface which forms a separate unit of roadway distinct from the tracks.

They form a satisfactory edging for paving guards for bituminous, macadam, brick or block, or concrete roadways.

They are of very simple construction, consisting of an ordinary angle of the required dimensions with the horizontal flange engaging the underside of the pavement surface and bonded to the concrete foundation by means of transverse twisted lugs punched out of the body of the horizontal flange and integral with it. They are furnished in lengths of 15 feet, straight or curved, and are provided with anchorages 10 inches long and 2 feet apart on centers.



VENTURI TUBE AND DIAPHRAGM ASEMBLE

DRY CHEMICAL FEED MACHINES

The Pittsburgh Filter & Engineering Company has put on the market two types of machines for the automatic feeding of exact predetermined quantities of dry chemicals for the coagulation of water supplies, that have already been installed in more than thirty-five cities throughout the United States. The method has been demonstrated and tested under severe working conditions and has been highly endorsed by engineers and water works men.

The type "O" machine, designed to feed any chemical in the dry state, has a conical hopper, a self-starting duplex water motor, feeding mechanism placed in a separate casting and a mixing box. It will feed up to 1,500 pounds of lime or up to 3,000 pounds of alum in twenty-four hours and is designed for plants treating not more than 2,000,000 gallons of water daily.

The type "P" machine has a standard hopper of 19 cubic feet capacity and a range of from 100 to 16,000 pounds per twenty-four hours. It is designed for plants treating 100,000,000 gallons or more of water daily. The machine is designed to operate manually or automatically or to be arranged in battery. The first machine built has been in operation in the city of Toledo filtration plant continuously day and night and has not required any attention or given serious difficulty, while the results of the treatment of the water are more uniform than by the old solution method. The machines are now in use in plants having capacities of from 1,000,000 to 52,000,000 gallons daily.

HOW TO BUILD "ASPHALT MACADAM" ROADS

The new booklet of the Asphalt Sales Department of the Texas Company entitled "Texaco Asphalt Macadam" is now ready for free distribution on request. It tells the proceedings in constructing Texaco asphalt macadam roads, starting with the foundation and discussing the process step by step to the finished pavement. Cross-sections are clearly drawn to illustrate the work as it progresses and photographs of actual construction add to the thoroughness of the literature.

THE SANITATION OF CITIES

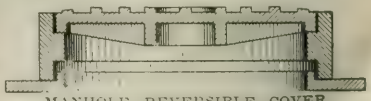
This book issued by the Sanitation Corporation is beautifully printed on heavy paper and contains chapters on the city plan and the sanitary utilities, water supply and removal of sewage, the purification of water supply, sewerage system, the sewage treatment problem, the biological treatment of sewers, difficult problems found in treating sewage, the mechanical treatment and purification of sewage.

It outlines various sewage treatments, processes, describes their installation in this country and in Europe and has handsome half-tones of cities and streets in America and abroad. It gives general impressions without much detailed information.

TYPE O DRY FEED MACHINE

ECONOMY REVERSIBLE MANHOLE CURB

This appliance, manufactured by Campbell, Wyant & Cannon, is designed to prevent the constant breaking up of pavement for replacing of manhole and catch basin curbs. It consists of three parts, an ordinary cover, a reversible, supporting ring and a base flange. It eliminates the heavy base heretofore extensively used and saves about 90 pounds of the weight of the



MANHOLE REVERSIBLE COVER

latter. The reversing feature of the supporting ring, practically provides a double curb at the cost of a single one, and can be readily taken out, reversed or replaced without breaking the pavement. It can be handled by one man and is estimated to effect an economy of $3.60 for the first installation, $52.60 for the second installation and $46.10 for the third installation, making a total saving of $102.30.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879

Vol. 50 FLORAL PARK, MARCH 19, 1921 No. 12

Mechanical Snow Removal

Heavy snowfall quickly handled in hundreds of miles of New York streets by caterpillar tractors, plows and trucks.

The storm commencing about midnight of February 19 brought to New York in one day a snowfall of more than 12 inches accompanied by strong winds, making high drifts. Before daybreak preparations for removing the snow were commenced, and the large new $2,000,000 mechanical equipment of the street cleaning department was in readiness. More than fifteen thousand men, including employees of this department and some from the fire department, were mobilized for operations so vigorously that 19 hours after the storm began no less than 930 miles of streets had been so far cleared as to prevent serious obstruction and to maintain possibility of traffic in the most important thoroughfares. On the second day the street clearing was so far advanced that fire danger from snow conditions was considered to be past, and in another day or two the business and most of the residence streets were well cleared, although for some time longer snow remained piled in banks along the curbs of many of the streets, where it did not materially interfere with pedestrians or vehicles.

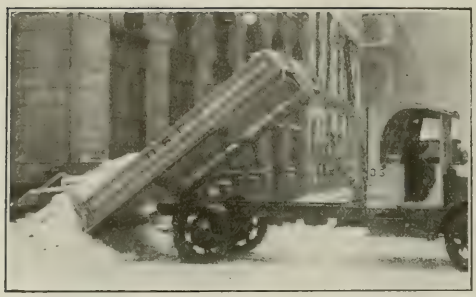
The important feature of this operation was the rapid removal of the snow from the center of the street and its collection along the curb by a fleet of tractors operating plows and the subsequent removal of the snow piles by the tractors pushing it to sewer manholes, and by power-dumping automobile trucks.

There were employed fifty 5-ton Holt caterpillar tractors rated at 40 engine h. p. and 25 drawbar h. p., which were equipped with Good Roads blade plows having blades 10 feet 6 inches long and 22 inches high, adjustable to any required height to clear irregularities in the pavement or to any horizontal angle with the direction of travel, and here set at 45 degrees, giving a cut 8 feet wide.

The tractors were assigned in pairs to prearranged routes, where they worked simultaneously in echelon passing up and down the street together, the forward tractor operating on the left-hand side of the center line of the street and pushing the snow toward the left curb while the rear tractor operated on the right-hand side of the center line, pushing the snow toward the right curb. Together they cleared a 16-foot space and then returning on the opposite sides, pushed the snow up to the curbs, making banks from 4 to 6 feet wide and about 5 feet in maximum height. They were operated successfully over all kinds of pavements, including some very rough cobble stones,

CATERPILLAR TRACTOR PLOWING SNOW FROM CENTER OF STREET TO CURB

MOTOR TRUCK EQUIPPED WITH PLOW TO SCRAPE SNOW TO CURB



MOTOR TRUCK DUMPING SNOW AT SEWER MANHOLES

and through drifts up to 6 feet deep at a speed varying from 3 to 5 miles per hour.

Their operation was commenced soon after the beginning of the storm and maintained continuously through it, thus preventing heavy obstruction and completing the removal of the snow from the middle of the street soon after the cessation of the storm.

After the centers of the streets had been cleared the tractors were equipped with plows having wings at both ends, with which the snow banks were attacked and large masses of snow pushed over the open sewer manholes, into which the snow was shoveled by gangs of men stationed there while the tractors returned for more snow. For this purpose the sewers were classified in accordance with their capacities, the largest ones being able to receive and dispose of unlimited quantities of snow, while smaller sewers could safely dispose of limited quantities, but care had to be taken not to obstruct them. No attempt was made to deliver snow to the smallest sewers.

The snow that was not disposed of through the sewers was removed as rapidly as possible by all manner of available trucks, both automobile and team-drawn, which were filled by an army of shovelers and by some experimental power machines. The truck service included 212 White 5-ton power-dumping motor trucks purchased for the routine removal of garbage, ashes and refuse, as well as for their availability in a crisis of this nature. The trucks hauled the snow to the nearest places where it could be dumped into the rivers, or to sewers. Some of the trucks were also equipped with scrapers and operated similarly to the tractors.

Each caterpillar machine required a crew of two men, one to operate the tractor itself (members of the fire department were used for this) and a street cleaning employee to operate the plow. Each machine used about 2½ gallons of gasoline and 3/10 of a quart of lubricating oil per hour. They worked continuously for many hours, developing ample power to do the heavy work and maintain remarkably high speed, and although they were handled by rather inexperienced operators no serious accident or breakdown was reported.

The main thoroughfares in the congested districts, chiefly below 14th street, were first attacked and afterwards the tractors were moved up Broadway and Riverside Drive and through the side streets between 59th street and 110th street.

On February 21, John Kenlon, chief of the New York Fire Department, said: "Fire danger from snow conditions is at an end. The streets are in such condition now as to give us little trouble in getting equipment to fight any blaze. The city won the wrestling match in this snow storm by a clean fall. It is the first big snowfall that has ever been handled within the first two days."

Street Cleaning Commissioner John P. Keough stated that the showing of the department was a clear demonstration of the power of scientific attack of snow by modern methods and that "apparatus costing more than $2,000,000 has been used for the first time on this snow and in my opinion it has paid for itself already. If this had not been used the private waste and loss to business in New York, due to obstructed streets, would have amounted to $10,000,000. Snow is going to be fought largely by machinery in the future."

A storm in New York a year ago required 12 days for the removal of the snow and it was estimated that the obstruction to traffic and delay entailed an economic business loss of $60,000,000.

The direct cost of removing the snow from this 12½-inch snowfall has been officially reported as $800,000 for emergency labor, $475,000 for extra pay to regular city employees, and $525,000 for truck contractors, no allowance being mentioned for gasoline, oil, repairs or overhead. The labor items, aggregating $1,275,000 plus regular wages of city employees, are sufficient to pay for 255,000 man-days at $5 a day. Twenty per cent for annual depreciation, repairs and interest on the equipment would seem to be a moderate allowance, and allowing one half of this for this storm (although it was the only one of the winter) would add $200,000, giving a total of $2,000,000 for removing the snowfall, in addition to the regular wages of the employees of the Street Cleaning and Fire Departments. The weather was extremely favorable, the sun having melted off the untouched snow by the time the snow forces had shoveled up the last of the piled snow.

It is probable that there has never before been such a high cost of removal of a storm of this depth under similar conditions. There was, to offset this, the advantage that never before had the main avenues been cleared so quickly for street cars and a practicable single traffic way on each side of them. In view of the vital importance of traffic to New York, this speed in providing for it was probably worth several times the million or more dollars it cost.

A Country Without Roads

Newfoundland, a British colony, is said to contain very few roads since practically all of the settlements are along the shore. English capitalists are about to establish paper and pulp mills on the island and the first necessity will be to build a system of roads leading from the coast into the interior where the plants will be located.

Trailers in Refuse Collection

More than a dozen cities have adopted this system and others are contemplating it. Some figures are given from service use in Indianapolis and Utica. With proper routing and careful management, this system is much cheaper than horse hauling, where the conditions are adapted to it.

The idea of employing trailers in collecting garbage, ashes and other municipal refuse is increasing in all sections of the country, the general features of such collection being those described by us in the issue of January 17, 1920.

The latest information at hand gives the following cities as now using the trailer system: Syracuse, N. Y. (40 trailers); Utica, N. Y. (16 trailers); Dallas, Tex. (30 trailers); Indianapolis, Ind. (25 trailers); Bridgeport, Conn. (16 trailers); Passaic, N. J. (6 trailers); Detroit and Highland Park, Mich.; Cleveland and Akron, Ohio; Gary, Ind.; Kenosha, Wis.; Memphis, Tenn.; and Norfolk, Va. Other cities are considering and some of them are trying out the trailer system, these including Savannah, Ga., Philadelphia, Pa., Youngstown, Ohio; and Hoboken, Jersey City and Newark, N. J.

One reason for the increase in use of trailers is the fact that with the growth of cities longer hauls are necessary to find dumping places for ashes; that when garbage is used for feeding to hogs, the hog farms are placed at some distance from the city; and that the same is true of reduction plants. Long hauls by teams are too costly of operation and, because of low speed, require too many wagons and drivers.

In the matter of cost the experience of Indianapolis may be cited. Up to 1919 the Indianapolis Hauling Co. held a contract for removing ashes from the homes of the city and offered to continue the service during 1919 for $81,000 a year, with $51 additional for each acre of annexed territory, the contract to continue for five years. This price seemed so large that the city decided to perform its own collection and for this purpose bought four 5-ton trucks and 25 trailers. During 1919 these trailers collected 115,286 cubic yards of material and hauled it to the dumps. The operating cost, including oil, gasoline, tires, repair parts and labor, totaled $12,305; depreciation on an estimated life of seven years was $8,286, while 6 per cent interest was $2,784. The pay roll was $53,063, bringing the total cost up to $76,139, or about 66 1-3 cents per cubic yard of ashes collected. Meantime the city had annexed considerable territory which would have made the cost by the contract terms offered nearly $100,000. Each of the trailers held 4 cubic yards and each tractor pulled a train of 3 trailers and made six round trips a day. Four trucks and 24 trailers averaged 288 cubic yards a day, each cubic yard weighing between 1,100 and 1,200 pounds. Twenty-four trailers were in use, 12 being drawn by the four tractors to the dumps while the other 12 were being hauled by horses through the streets and collecting the ashes.

Between 90 and 100 tons of garbage are collected daily in Indianapolis, the collection being made by three 5-ton horse-drawn wagons by which the garbage is carried to a loading platform in the central part of the city where the garbage is loaded on cars and transported to the reduction plant located about four miles from the loading platform. The wagon hauls range from a few blocks up to 5 miles and the average number of loads per day is three. Some time ago a fire at the loading platform put this system out of commission for three weeks, and during this time the trucks and tractors were used for garbage collection also. It was found that one truck in an hour and a half collected as much garbage as a horse-drawn wagon collected in a day, including covering the four miles to the reduction plant instead of to the loading platform only.

This same system of operation, as previously described in former articles, is employed by all cities using the tractor and trailer system—the trailers are drawn by horses while collecting the garbage or ashes, are left at fixed points where are found empty trailers with which the team renews collection, while

COUPLING UP TRAIN OF TROY TRAILERS IN MEMPHIS, PREPARATORY TO HAULING GARBAGE TO INCINERATOR. Capacity 4 to 4½ cu. yds., rounded load. Height to loading edge of body, 60 in.

OTHER ILLUSTRATIONS: THE TWO ILLUSTRATIONS ON THE FRONT COVER SHOW, THE UPPER ONE A 3½-YARD "HIGHWAY" TRAILER STARTING ON A COLLECTION TRIP IN SAVANNAH, THE LOWER, A TRAIN OF "ARCADIA" TRAILERS IN NEWARK, N. Y.

LEE TRAILERS WITH WHITE TRUCK TURNING A CORNER, HAULING ASHES IN INDIANAPOLIS

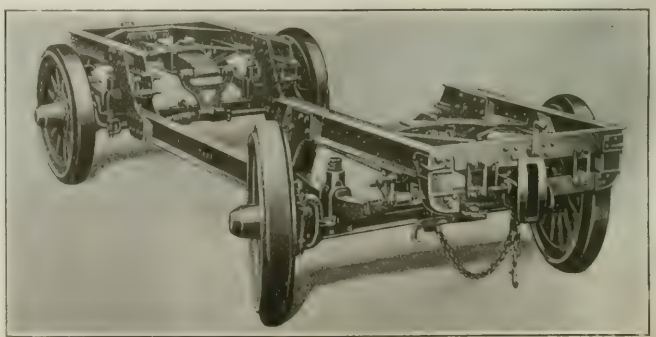
the tractors pick up three to five filled trailers and transport them to the dumps, incinerators, hog farm or other point of disposal. The capacity of a train of trailers ordinarily ranges from 12 to 20 cubic yards, and the speed from 8 to 12 miles an hour depending on road conditions, grade and number of trailers hauled.

Utica also began using tractors and trailers in 1919 for hauling garbage to a pig farm about 4 miles outside the city. It purchased two 5-ton trucks, sixteen 3½ yard trailers and 8 teams. Each team drawing a trailer is accompanied by two men and obtains a full load in 1½ to 2½ hours. Each truck carries four trailers at a time. The route to the pig farm is over unimproved country roads with grades of 7 to 8 per cent in some places. The 8 mile round trip requires about an hour, this including about 8 minutes for dumping the trailers and 10 to 15 minutes for uncoupling and coupling the trains in the city. The truck drivers are paid $3.50 a day and the other men $3.00. Six hours constitute the average day's work. An average of 749 tons per month is collected and hauled at a total cost of $4,032. Formerly when teams were used for all hauling, the average length of haul was only 1.6 miles. The ton-miles hauled by teams averaged 900 per month at a cost of $2.54 per ton-mile, while with the trailers the cost for the 3,000 ton-miles, including depreciation and all overhead, was $1.35 per ton-mile. Of this, labor and supervision constituted 55 per cent, supplies 7 per cent, and operation 22 per cent.

DESCRIPTION OF TRAILERS

Several companies are now furnishing trailers especially adapted for municipal work, one of their greatest advantages being the comparatively low lift of garbage or ash receptacles required in filling the trailer, the edge of the body being only 5 to 6 feet from the road, or 4½ to 5½ feet from the sidewalk level. This is accomplished by using a chassis with a drop frame. A general description which will fit almost any of the trailers is as follows: The drop frame chassis is fitted with a steel body that rolls to either side for dumping, an automatic lock holding the body in horizontal position and chains keeping it from rolling off the chassis when dumped. They are reversible, running equally well in either direction and steering by whichever pair of wheels is at front, the rear pair being locked in alignment with the frame. A train of any number tracks with the truck or tractor when turning corners. A swivel draw head with bumper is provided at either end for coupling the trailers together, the draw head having springs to cushion the shock of starting and stopping. A draw bar is provided for attaching the first trailer to the rear end of the truck or tractor and a tongue for hitching the team to the trailer. Some makes have a seat at either end for the driver of the team. Steel frames are generally of I-beam or channel construction. There are steering knuckle axles with roller bearings for the wheels, semi-elliptical springs, shackled to the frame, and solid rubber tires. The special trailer mechanism is a drawhead swivelled to draft beams bolted to the frame and connected by hinged yokes and tie-rods to the steering arms. The weight of a trailer, complete with body, is about 4,000 pounds for the 2-ton size, 5,000 to 6,000 pounds for the 3 to 3½-ton size, 6,000 to 7,500 pounds for the 5 or 6-ton size. The prices are approximately $1,885 for a 2-ton trailer, $2,100 to $2,550 for the 3 to 3½-ton, $2,500 to $3,500 for the 5 and 6-ton.

A good truck is able to draw two or three loaded trailers if the grades do not exceed 5 or 6 per cent and the streets are hard surfaced. An ordinary team of 1400-pound horses can draw a 2½-yard trailer in collection work six days a week under similar street conditions. Their daily travel is only from 10 to 15 miles, the trailers run easily on roller bearings, stops are frequent so that the animals get plenty of rest, and the trailers start empty each time and do not accumulate their full loads until near the end of the collection route.



CHASSIS FOR 3-TON DROP-FRAME TRAILER
All-steel construction, double end steering and connections to coupling draw heads

To secure the maximum efficiency with the use of trailers requires careful study and management, routing of trailers in collection, location of stations where trains and trailers are made up, etc. It will ordinarily require a little time of preliminary use in actual service for the schedule of maximum efficiency to be determined upon and for training the employees to work rigidly to the schedule adopted. The tractor must not have to wait many minutes for the arrival of the loaded trailers, nor should the teams have to wait long for the arrival of the tractor with empty trailers with which they can again begin collection. The number of trailers and capacity of tractor must be carefully estimated by a study of the size of city, density of population, grade of streets as affecting collecting time for filling trailers and amount which horses can draw. With all these properly considered, however, and where the refuse is to be hauled more than a mile or two after the collecting vehicle is filled, there would seem to be little question that in the majority of cases the tractor-trailer system would be much more economical than doing all of the hauling by horses.

HIGHWAY TRAFFIC

Report of a committee of the New Jersey State Association of County Engineers, gives synopsis of results of a questionnaire.

The New Jersey State Association of County Engineers in 1919 appointed a committee on present and future traffic conditions, which committee submitted its final report a few weeks ago. In the meantime it had sent a questionnaire to the various state highway departments and to a number of engineers of counties and of cities. Replies were received from 23 state highway departments, 21 counties in 7 states, 5 cities in 4 states, and a chamber of commerce, automobile club and the auto trade association.

That there is a lack of dependable traffic data in the country and no common terminology of traffic nor common basis of information obtained is the conclusion of the committee after studying the 52 replies received to its questionnaire.

Such traffic data as are available have been taken in different ways, with different units and for different periods of time, so that comparison is impossible and unavailing. For instance, one informant suggested that 2,000 be taken as the limit of "light traffic," while another suggested that 200, but the context indicated that the former meant the pounds weight of a single vehicle while the latter meant the number of vehicles per 24 hours. This illustrated that the word "light" is commonly used in both senses.

In its questionnaire the committee asked for the opinions of those replying as to what terms should be used in traffic classification, asking whether the terms "heavy and light" should be used or "commercial and pleasure"; also whether the classification should be based on maximum traffic or on average traffic. In this question it apparently made no effort to solve the confusion between weight of vehicles and number of vehicles in the use of the above terms. In the replies, 33 recommended "heavy and light" and 19 recommended "commercial and pleasure"; 29 suggested that the average or average maximum traffic be made the basis of classification and 27 that the maximum be so used.

Of 47 replying to the question whether they had taken dependable traffic records, 33 had no records at all and 14 others had records of which only a few were considered dependable.

Paved portions of roadways were reported as varying from 9 feet to 60 feet in width, 36 naming 18 feet and 25 naming 16 feet. The space from gutter to gutter varied from 20 feet to 60, between 24 and 36 being the widths generally required, with 32 as an average. The width of the entire roadway between property lines varied from 20 feet to 120, with 50 most common and 60 as the average of all.

Twenty-four of the replies stated that some of the roads had reached the traffic limit, and thirty replied that none had yet reached such limit.

Replies to inquiries as to the probable percentage in automobile traffic during the next 10 years showed opinions varying from 30 to 500 per cent, with the general belief that commercial traffic will increase faster than pleasure. There was practically unanimous opinion that total loadings would tend to increase.

In replying to some general questions, there was a practically unanimous opinion that railroad grade crossings should be eliminated; that pavement widths should be greater in populous sections, although only about three-quarters considered greater width necessary for roads; while the suggestion of parallel roads on main routes to provide for one-way traffic roads and for dividing commercial and pleasure traffic was approved by 22 and disapproved by 7.

The committee paid special attention to the matter of classifying traffic and quoted the units used as the basis of counts by different cities and counties. It presented a traffic census sheet as a suggestion for a standard to be adopted throughout the country generally. This classified the traffic as follows: Motorcycles, light horse, heavy horse, pleasure motor cars, light motor trucks, and heavy motor trucks, each of these except motorcycles being further divided into empty and loaded; also 10-ton specials, 15-ton specials and over 15-ton specials, and street cars. The last column is provided for the total. A line is given for each hour of the 24. The assumed weights of the several units are given as follows, in tons: Motorcycles, 0.25; light horse, empty, 1.25; light horse, loaded, 2.00; heavy two-horse, empty, 3.20; heavy two-horse, loaded, 6.20; light pleasure motor, 1.50; heavy pleasure motor, 2.50; light motor truck, empty, 1.00; light motor truck, loaded, 2.50; heavy motor truck, empty, 5.00; heavy motor truck, loaded, 10.50.

In an effort to provide some method of classifying roads in accordance with number of vehicles using them, the committee recommends that roads carrying 100 vehicles per 24 hours be called traffic No. 1 roads, those carrying 200 vehicles traffic No. 2, etc. This would still leave the character of the traffic undescribed and this would vary greatly in different sections and on different roads.

It is also recommended that traffic counts be taken on each road 4 times a year, on 3 consecutive days each time, each period to include a Sunday or other heavy-traffic day.

A few general suggestions were given by the committee in concluding this report, among these being that plans for highway systems should be made for a period of 20 years ahead, subject to such modifications as future developments or knowledge might indicate; that wide rights-of-way be obtained and roads laid out with flat curves and easy grades. Also that wider and stronger bridges be built so as to provide for increase in number and weight of vehicles during the 10 or 20 years which should be the least life of the structure.

Good Roads in Argentine Republic

The Argentine Republic has recently organized a good roads association which already has about 300,000 members and which is backed by the Minister of the Interior and has been promised every possible aid by the government.

The Indiana Highway Commission

The State Board of accounts of Indiana on February 17 submitted a report on the Indiana State Highway Commission which has occasioned considerable stir in that state. The report goes extensively into some of the methods and certain specific doings of the board and recommends a number of changes in the method of administering the state highway department. The governor has stated that he regards the trouble in the highway department as mostly administrative and is not in favor of any radical changes in the department itself.

The most important changes have to do with the finances of the department rather than the results obtained. It recommends that payments be made for road work by the auditor of the state directly to the persons to whom the money is due, rather than to the director of the highway department to be in turn paid out by him from time to time; it having been the practice to turn over to the director sums of $100,000 at a time, which sums he would place in the bank to his account to pay out as became necesary. Many purchases had been made without obtaining competitive bids as the law required. The cost of "administration, salaries, new equipment, repairs of equipment, transportation and all other expenses pertaining thereto" was 31.7 per cent. of the total expenditure in Indiana, but only 5.7 per cent. in the state of Ohio. The minute books of the department are said to be incomplete and confused in their records. Advances of freight costs were made to certain contractors without any legal authority therefor, which also was considered unfair to the other contractors. Testing laboratories were paid $5,000 for testing road materials although the law provides that this shall be done by Purdue University.

Governor McCray does not believe that any legislative action is needed. The board was not organized until 1919 and was immediately called upon to spend approximately $5,000,000, and undoubtedly fell into some mistakes which would not have occurred had it had opportunity to develop and organize leisurely. Some are now advocating the entire abolishing of the highway department and turning the work back to the counties, but it does not seem probable, as it certainly is not desirable, that this be done, however necessary it may be to improve the methods by which the state highway department operates.

The Georgetown Bridge*

Construction of floating falsework and erecting and shifting trusses.

FALSEWORK

The arch trusses, in pairs 7 feet apart on centers, rigidly braced with transverse and diagonal angles, were erected on floating falsework, in preference to erecting them in position on piers by derricks installed on the bridge piers or swinging them to place by a large floating derrick which was not at hand and could not be economically built for the purpose. The falsework consisted of a center tower under the crown supporting the lower chord for a distance of 97 feet, and two inclined jack bents supporting the lower chord at the haunches about 65 feet each side of the center point.

The falsework was made with nine transverse bents each having two inclined posts braced with transverse struts 8 feet apart vertically and the panels X-braced with planks spiked on. The center bent is made with 12 x 12-inch batter posts and the others with 6 x 6-inch batter posts, all of them resting on a group of pontoons firmly braced together.

The 24 x 80-foot center pontoon has its axis coincident with that of the pair of arch trusses and is firmly secured to a transverse 22 x 75-foot pontoon at each end of the group, making a symmetrical letter H, with the ends of the transverse pontoons tied by ¾-inch wire rope to the center points of the long sides of the 24 x 80-foot pontoon.

The pontoons were reinforced by a set of ten 12-inch I-beams parallel to the bridge axis across the deck of the center pontoon, and at each end and overlapping at their ends a set of six 12-inch I-beams continued across the extremities of the 80-foot pontoon and entirely across the full width of the transverse 75-foot pontoon.

The I-beams were securely clamped together at short intervals by ¾-inch U-bolts and bearing

*Continued from Page 223

plates engaging them and the solid fillers, and were also clamped to the decks of the pontoons by top and bottom yoke timbers extending across the full width of the pontoon and connected by vertical tie rods with nuts at both ends. The end tower bents were supported on the decks on the transverse pontoons, adjacent to the bearings for the inclined bents that took very heavy loads from the trusses projecting cahtileverwise a long way beyond them.

The pontoons and falsework draw about 2½ feet of water and the weight of a pair of ribs displaces one additional foot of water. This was an important point in determining the height of the falsework.

ERECTING TRUSSES.

The pontoons with falsework were anchored close to and on the down-stream side of a completed pier on the Virginia side. As the boom on the derrick scow could not reach high enough to place the center section of the ribs, a gin pole was placed on top of the pier and leaned over the edge toward the scows.

In starting the erection, the two center sections of one rib were placed first, then the corresponding sections of the second rib. After this a section was added to each rib on one side of the center and then a like section added to the other side in order that the load would be more uniform on the scows.

All joints were milled and made so that a little drifting was required to draw them up tight. The steel connections were bolted, therefore by a little drifting on the holes a much better joint was obtained. Each joint was fairly well bolted up before hanging the next section.

Four winches were placed on the pontoons, one on each end of each of the end pontoons to handle the four 3-inch anchor lines, two down-stream to concrete blocks dropped on the river bed, and two up-stream fastened to piers of the old Aqueduct bridge.

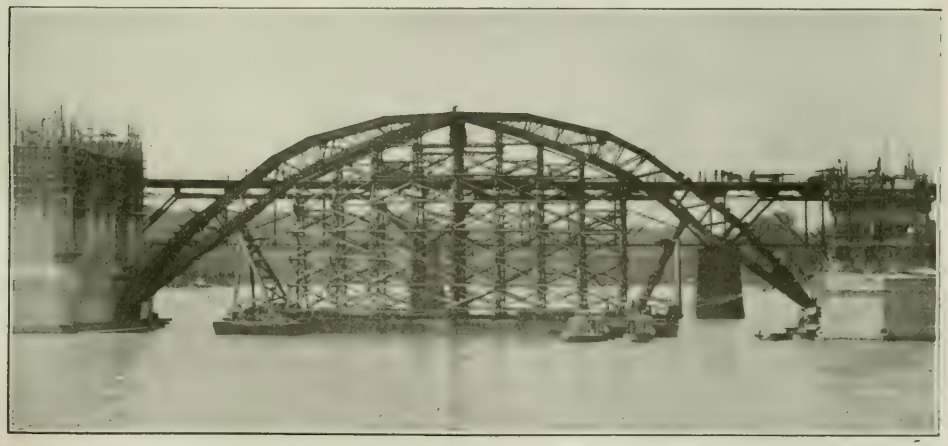
The river at the bridge has a tide variance of from 1 foot to 3 feet, which was taken advantage of in placing the steel. At least 2 feet of tide was necessary, preferably more, due to clearance required and the pontoons being submerged 1 foot. The operations were calculated for mean low water. Heavy rains on the water-shed of the Potomac caused a week's delay in placing the first set of ribs. If the wind blows down the river for some hours it has an appreciable effect on the water level.

The falsework and ribs expose quite a surface to the wind and its pressure is noticeable. All of these things and time of high tide were considered in setting a date to float a pair of ribs in place.

The up-stream hawsers were strung between the piers of the 208-foot span, thence across the river to the pontoons and fastened to the winches. The down-stream hawsers were run from the winches diagonally down-stream across to the concrete anchors. Several holding lines of 1½-inch manila rope were fastened wherever they could be, and had to be changed several times. By taking in on the hawsers with the winches and paying out on the holding lines the falsework and ribs were hauled across the river to the center span and then pulled directly up-stream into place, final adjustments being assisted by lines attached to eyebolts built into the piers for that purpose.

Just before going in between the piers four tackles were rigged from the pontoons to the piers, one from each corner, to prevent any side movement and to help in pulling up to final position. When the final position was reached four turnbuckle rods were attached to the ribs and the piers, one up-stream and one down-stream at each end, to hold the ribs in the exact position required. The steel wedges were dropped in place between the shoes and the wall plates and held in position.

As the tide ebbed the ribs descended until the shoes rested on the grillage beams and slid back



FIRST SET OF ARCH RIB TRUSS CENTERS IN POSITION BETWEEN PIERS 2 AND 3 AND STILL SUPPORTED ON FLOATING FALSEWORK ON WHICH IT WAS SUBSEQUENTLY TRANSFERRED TO ANOTHER SPAN.

until the steel wedges caught tight. Just about the time the shoes started to slide back the through bolts at the crown pin were loosened so the ribs could adjust themselves. This was an important point for the milled surfaces of the cast steel hinges are on radial lines. When the tide ebbed sufficiently the weight on the pontoons was released and they finally floated free. The pontoons and falsework were worked out and back across the river, to get another pair of ribs, by the same lines that pulled them into place.

The second pair of ribs was placed alongside of the first pair in exactly the same manner, but in order to hasten the work and finish before dark about one foot of water was pumped into the center pontoon. Sheet lead was placed under the shoes to give a uniform bearing.

The foreman and about 14 structural steel workers averaged about 14 days of eight hours in assembling a pair of ribs on the pontoons and falsework, also an engineman and fireman were needed to work the gin pole when being used and the same required on the derrick scows when it was in use. About 75 men were used to place the first pair of ribs, but profiting by experience, the fourth pair of ribs was placed with 9 men, there being no wind to contend with.

RIB FORMS

On the top chords of the arch trusses there were bolted, close together, 12-inch transverse I-beams 20 feet 9 inches long, overhanging the centers of the trusses about 2½ feet at one end and 7¼ feet at the other end. These beams supported 9 x 12-inch timbers 3 feet apart, that were parallel to the trusses and carried the 3-inch transverse lagging planks 18 feet long which made the bottoms of the forms for the arch ribs. The 9 x 12-inch timbers were dressed convex on the upper side to correspond with the curve of the intrados, and were blocked up on top of the 12-inch I-beam flanges as necessary to bring them to the exact elevation.

After the center rib was concreted the two pairs of trusses under it were moved apart transversely until they were concentric with the outside ribs which were concreted on them simultaneously.

The vertical side walls of the rib forms were made of horizontal boards nailed to the inner faces of vertical outside posts bearing against three rows of horizontal waling pieces through which ½-inch tie-rods extended across the rib with nut and washer bearings at the end. The lower edges of the side walls engaged the vertical faces of 3 x 6-inch waling pieces bolted to the floor lagging and the bottoms and middle points of the walls were braced by inclined outside struts with their lower ends engaging angle blocks bolted to the top flanges of the 12-inch transverse I-beams at their extremities.

The blocking, decking and form for an arch ring were built in about two months by about 25 carpenters and three foremen with whatever aid was required by a derrick scow or the cableway. A foreman and 8 carpenters generally worked about three days in building the form for a pocket of a single concrete section and placing a small amount of reinforcing steel at the intrados and extrados and construction joints where a girder or column would connect.

CONCRETING

Concrete is made with cement delivered by the railroad on a track running under one end of the bridge, and sand and gravel are transported by water and unloaded by a clam-shell bucket operated by a derrick boom.

A floating concrete plant was installed on two pontoons lashed together side by side, having an Insley tower, ¾-yard mixer and storage bin on one end and at the other end a boiler and stiff-leg derrick rigged with a ¾-yard Blaw-Knox power wheel bucket to handle sand and gravel from scows into the bin over the mixer. The plant is towed wherever wanted and is very efficient.

The concrete not mixed in the floating plant is mixed in a land plant served by a Lidgerwood cableway of 1,700 feet clear span and stationary towers 145 feet high. This cableway distributed both concrete and materials along the full length of the bridge.

A 208-foot arch ring of the 208-foot span was concreted in 13 pours of 25 blocks. A key was left at the crown to be poured last and on either side of the crown a form was built to pour a block. These two were poured first, then a block on either side at the haunches, then alternating between the crown and the haunches and finally the keys at the crown. Two corresponding blocks of concrete were nearly always poured in one day. The bulkhead of a section was taken off the next morning after pouring, the side forms were left on till all concrete was poured, but were taken off a couple of days after completing the arch ring. The steel ribs were left in position 30 days after pouring the key at the crown.

SHIFTING TRUSSES

When ready to remove the steel ribs, the pontoons and falsework were floated in underneath at low tide and held in position until the tide had risen high enough so that the water displaced by the pontoons after bearing heavily against the ribs was more than equal to the weight of a pair of ribs, which is about 200 tons, the wedges were released and the ends allowed to drop so that the ribs took bearing on the jack posts. To aid in removing the wooden wedges hydraulic jacks are used to lift heavily against the concrete and compress the timber blocking. When the tide ebbed the pontoons floated out.

The other principal items of plant involved in the construction of the bridge include two derrick scows and one boiler scow, two 5-inch pulsometers, one 6-inch Emerson pump, one 8-inch pulsometer and one Ingersoll-Rand air compressor.

The floating equipment was largely owned by the Engineer Corps of the United States Army. The cableway was operated by a Lidgerwood hoisting engine located at the Georgetown end and was equipped throughout with Leschen wire rope, including the main cable 2¼ inches in diameter.

Construction was commenced in August, 1917, under Col. W. L. Fisk and is now in charge of Major M. C. Tyler, District Engineer, and Major L. E. Oliver, Resident Engineer.

PUBLIC WORKS

Published Weekly
by
Municipal Journal and Engineer Inc
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.
New York, N. Y.

Subscription Rates

United States and Possessions, Mexico and Cuba ..... $3.00 per year
All other countries ..... $4.00 per year

Change of Address

Subscribers are requested to notify us promptly of change of address, giving both old and new addresses

Telephone (New York) Bryant 9591
Western office Monadnock Block Chicago

A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

CONTENTS

MECHANICAL SNOW REMOVAL—Illustrated ... 233
A Country Without Roads 234
TRAILERS IN REFUSE COLLECTION—Illustrated 235
HIGHWAY TRAFFIC 237
Good Roads in Argentine Republic 238
The Indiana Highway Commission 238
THE GEORGETOWN BRIDGE—Illustrated 238
EDITORIAL NOTES 241
Promising Anti-Strike Action—Collecting Refuse
Inspecting Water Works Valves 242
Strike Insurance 242
Road Bids High 243
Patented Pavements Permissible 243
Alabama's Highway Bond Election Illegal 243
Road for New York-New Jersey Tunnel 243
HOW CAN A SMALL QUANTITY OF FINE SAND BE GRADED FOR USE IN A FILTER? Illustrated 244
Federal Aid Appropriation Postponed 245

Promising Anti-Strike Action

The menace of industrial and construction strikes is an increasing evil that has cost this country probably more than the direct war debt. Its danger is due to the organization of unions and their unscrupulous methods, but with the elimination of the organization alone its terrors would vanish. The unions have been able to concentrate their combined resources in the aid of any given strike and, aided by political influence and class legislation, have generally been more powerful than their opponents, who have effected little or no organization to oppose them.

The recent formation of an insurance company especially devoted to strike risks offers a very important advantage to individual and corporate employers, and makes possible a far stronger resistance to strikes by definite liquid assets that can already be measured by large sums of cash and can easily be developed, if it appeals (as it is likely to do) to business and capital interests, to amounts far superior to the resources of the union, large as the latter are.

Such support will not only give strength to contractors and owners and assist them in critical periods, but it will vastly increase their confidence and in similar measure will make the strikers hesitate. Obviously, if it flourishes, the strike insurance will effect a very real universal organization founded on the highest business, moral and financial principle and may do more than any previous methods have accomplished to produce co-operation and co-ordination in construction interests and greatly reduce the liabilities and losses therein.

Apparently the policies have so far been issued chiefly to shops and factories that have already collected payments in various states. There is however no reason why it should not be rapidly extended to all kinds of construction interests and operations, and whatever authorizations, legalizations and formalities are necessary should be quickly effected so that there may be no opportunities for attacks such as that of the Printers' Trades Association, which on a technicality has caused the temporary closing of the New York office. The prompt action of the union in making this attack is the best evidence that could be had of the importance of this new application of insurance and the necessity of defending and encouraging it.

Although the rates appear high, and many employers have heretofore been able to avoid large direct strike losses without formal insurance, it must be remembered that in most cases they have paid heavily by acceding to demands that, if refused, would have caused strikes which, had they been incurred, would have been covered by their policies. An extension of the policies to cover the losses of the owners through delay in construction and other consequential damages would evidently make the strike policies of enormous value to all of those closely concerned with construction work.

Collecting Refuse

More than $30,000,000 a year is spent in collecting refuse, and if all cities fulfilled their complete duty in this respect, the amount would probably exceed $60,000,000. Any improvements which will decrease the cost of this service will therefore make a material reduction in our municipal expenditures.

One of the latest developments is the use of trailers and tractors, as described in this issue. Where conditions as to amount of refuse to be collected, length of haul, grades and other conditions are favorable to this plan, it will apparently effect a considerable saving over the use of ordinary horse-drawn vehicles.

The advantage of the tractor is the speed with which it covers long distances and the fact that three or four collecting carts can be taken at once with a single tractor and driver. Where there is a single short hill up which the tractor could draw only one or two trailers at a time, it can break the train and carry the trailers up in several trips; but ordinarily if the hill is long or there are several of them, this condition eliminates much of the advantage of the trailer.

The trailers furnished for this purpose have several advantages over the ordinary collecting wagon. One of these is a feature which we have urged for years, but we feared to deaf ears, for only within a comparatively few months has it seen anything like general adoption. This is the reducing of the height

of the top of the body so that the refuse container need not be elevated more than shoulder high to dump it into the wagon. The trailers offered for refuse collection, with their drop frame, embody this most desirable feature. The bodies are entirely of metal and are watertight and are easily cleaned and do not absorb liquids or give off odors.

It has been reported by most who have made practical comparisons that it is considerably more economical to collect by horse-drawn vehicles than by motor vehicles, where conditions require only a short haul of not more than half a mile after the wagon is filled. Recently, however, one or two investigators have expressed the opinion that improvements in vehicles and increased cost of horses and the feeding and maintenance of them have greatly diminished this difference and may even reverse the advantage in certain cases.

In this country very little trial has been made of electric vehicles for collecting, but in England a considerable number of cities have tried electric motor wagons for collecting refuse and find them considerably more economical than the gasoline vehicles. Where the refuse is burned and the heat is used for creating steam, it would seem to be practicable to use this last for creating electric power which, in combination with storage batteries, could be used for charging the batteries of electric collecting vehicles. At least one city in this country has tried this plan, Paterson, N. J., having reported last year that it used four electric trucks and three gasoline, and that about half of the current for charging the electric trucks is obtained by use of the steam from its refuse destructor.

It seems certain that there is still great room for improvement in appliances and methods employed for collecting refuse and it does not seem unreasonable to anticipate that the cost of collection will be reduced by 50 per cent. Meantime, our progressing ideas as to the duties of municipalities in the collection of refuse will lead to increasing numbers performing this service more thoroughly than ever, so that on the basis of present costs the expenditures would probably increase in a few years to $60,000,000 or even $100,000,000 a year. Increasing the efficiency by 50 per cent would therefore probably mean the saving to the country of $30,000,000 to $50,000,000 a year—an amount certainly sufficiently large to serve as an incentive to an intelligent and exhaustive study of the subject and the evolution of improvements in its various processes and appliances.

Inspecting Water Works Valves

The city of Chatham, Ont., has been trying to improve the pressure in its distribution system in order to secure better fire protection, but without satisfactory results. Finally, a few weeks ago it was found that one of the water mains leading from the pumping station to the business section of the city was entirely out of service because of a closed valve which, as nearly as could be found out, had been closed two years previous for making repairs and had not been opened again.

Theoretically such a piece of carelessness should not have occurred, but oversights are always possible and even probable occasionally. There are probably scores of cities in this country in which at least one, and perhaps several, valves are closed undesignedly and are cutting down the effectiveness of the distribution system.

The only reliable method of avoiding such detraction from the full effectiveness of a system is to make periodical examinations of all valves in the system. Either by a map, a card catalog or other method, a list of all the valves in the distribution system should be recorded, each having its own number. The testing of the valves should then be insured by checking them off on the list each time and recording the date of test for each valve. The tests should include closing and opening the valve, listening meantime to ascertain that the valve when closed passes no water (which may be determined by the absence of any singing of the passing water). Also, inspection should be made to learn whether water leaks from the stuffing box when the valve is open. In addition to these periodical inspections (which it is desirable to make at intervals of six months if not less), the superintendent, or a trustworthy assistant, should visit every valve which is known to have been closed for the making of repairs or other purposes, to make sure that it has been opened again by the workmen engaged on such repairs.

Strike Insurance

There has recently been formed The Employers' Mutual Insurance and Service Company, Baltimore, with a capital of $2,000,000 that provides insurance against loss from labor strikes. It already covers 37 trades in 25 states, has directors of financial and industrial prominence in New York, Baltimore, Philadelphia and Boston, and has issued policies to more than 50 large industrial firms. It is said that a number of important insurance companies are preparing to take advantage of a new law pending in Connecticut that will permit them to assume risks of this nature.

Besides insuring against direct loss due to strikes, the company maintains a service department with local secretaries scattered throughout the country who act as mediators when required. It is estimated by the company that there may be more than 100,000 strikes in the next two years and that in those lines where the company has already operated 70 per cent of the threatened troubles have been averted.

It is reported that, for a premium of 1¼ per cent of the fixed charges and profits, the company will pay 80 per cent of actual losses up to the face value of the policy.

A branch office has been opened in New York City, and it is claimed that a large amount of insurance has been written there for local employers. Complaint was made by The International Allied Printing Trades Association that the operation of the New York office was in violation of the New York State Insurance laws and, asserting that it encouraged discord between employers and employees, they entered a protest with the State insurance commissioner, who ordered the representative of the insurance company in New York to suspend operations in that city.

Road Bids High

On March 2nd the Pennsylvania State Highway Department announced that it was rejecting all bids received on February 18th and 19th for construction projects in various parts of Pennsylvania. In connection with this, State Highway Commissioner Sadler announced that he felt that the prices submitted on a great majority of the projects did not reflect sufficiently the downward trend of prices for labor and materials; and while it was urgent that every effort be made to complete the contemplated construction program, on the other hand the resources of the state should be conserved.

The average cost of constructing roads in Pennsylvania last year was, we believe, about $60,000 a mile, but it is reported that the bids received for 104 miles of road this year averaged $70,000 a mile, thus being higher instead of lower, as the falling costs of labor and material would seem to indicate that they should have been. "The projects will be readvertized within a short time with a view to obtaining more reasonable proposals."

On February 18 the Ohio Division of Highways also received bids for about 125 miles of pavement and also for several miles of grading; but these bids were so high that Governor Small has directed that they be rejected.

Patented Pavements Permissible in Illinois

Under decision handed down by the Supreme Court of Illinois, an act passed in 1919 by the Illinois State Legislature regarding pavements is declared constitutional. Prior to that year, the use of patented pavements by the several cities of the State had been prohibited under the Supreme Court's decision of the then existing law. The Legislature then passed an act permitting municipalities to contract for patented pavements provided they are placed in competition with unpatented pavements.

Pursuant to this, the city of Rockford, Ill., received proposals for several types of pavement, including Warrenite-Bitulithic, patented by Warren Brothers Company, Boston.

A taxpayer, R. J. Schult, brought an action to restrain the contract on the grounds that the act of 1919 was unconstitutional and that the proceedings had not fully complied with the act. The Supreme Court in unanimous opinion written by Mr. Justice Carter decides against the plaintiff taxpayer on all points and sustains decision rendered by the County Court more than a year ago.

Alabama's Highway Bond Election Illegal

Early this year Alabama voters adopted a bond issue of $25,000,000 for road improvement, but the election was declared by the Supreme Court to be illegal because the legislature had delegated to the governor the appointment of the day for the election on the bond issue, whereas the constitution required the legislature itself to set the day. A rehearing was asked, but the Supreme Court reiterated its decision.

It is believed that this means either an extra session of the legislature or the losses of federal funds totaling about $4,000,000 which are available when the state of Alabama duplicates the sum for highway construction. At the time of this writing it is not known what the governor will do in the matter. The state highway department had perfected a state organization for carrying on the road work in order to be ready for actual construction at the earliest possible date, and had done a considerable amount of preliminary work. Contracts already let will require all the funds which the state can appropriate if highway bonds are not issued, and this probably will result in the temporary abandonment of the work which had been inaugurated.

Road for New York-New Jersey Tunnel

A report was submitted in February to the New York State Bridge and Tunnel Commission and the corresponding New Jersey commission, by an advisory transportation committee which had been requested to study some of the problems involved. This committee consisted of managers of motor vehicle departments of express companies and other firms using large numbers of trucks, such as the Borden Milk Co., Tidewater Oil Co., Burns Bros. Coal Co., and a few officers of motor truck manufacturing companies.

To the question what minimum width should be given a two-line roadway, having in mind traffic demands, cost of construction, maintenance and operation, and the difficulties of construction, the committee recommended a twenty-foot roadway as providing sufficient clearance.

To a second question the committee reported that the ultimate size of automobile truck will probably be determined by legislation or by conditions growing out of the width of existing highways, and that the width will probably be limited to eight feet.

In reply to other questions submitted, the committee recommended that all vehicles be compelled to keep in the line in which they start, not passing each other except in case of a wreck. It is believed that the roadway should not be crowned but should be flat and that there should be no grooves or curbs between the lines of travel, the only indicator being center line markers to assist the police in regulating the traffic. No repairs to disabled cars should be permitted in the tunnel if they involve a delay exceeding one minute, but any disabled truck should be immediately hauled out by special cars maintained by the commission for that purpose. The railroad system of signaling should be adopted. A sufficient police force should be employed to enforce the rules adopted so that the traffic can be handled expeditiously. Concerning the question of cleaning the railway of oil and gasoline so that a safe roadway may be had and fire hazard eliminated, the committee recommended the use of torpedo sand and mechanical sweepers, together with fire extinguishing apparatus of both emergency and permanent types.

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems different will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

How Can a Small Quantity of Fine Sand be Graded for Use in a Filter?

By washing in a filter. By washing with adjustable water supply in an overflow hopper. Accuracy and rapidity attainable with very simple equipment.

Editor, Public Works.

Dear Sir:

Can you inform me as to what would be the most economical method of washing approximately 150 cubic yards of sand, for filtering purpose. The sand as obtained from the bank shows an effective size of about 0.15 millimeter. It is required that the sand stand at least 0.25 millimeter.

I have tried screening with a 12 mesh to the inch screen, but find that not enough fine stuff can be removed by this method to bring the sand to 0.25 millimeter.

Any information you can give me will be greatly appreciated.

Very truly yours,
Contractor and Engineer.

It is generally impossible to sift fine sand accurately in large quantities in a reasonable time and cost and the simplest and most rapid and most economical method of grading it is by the wet process, which is generally a matter of suspension rather than of washing, although it generally serves to wash out loam, dirt and clay and leave the accepted sand clean and uniform.

UTILIZATION OF FILTER

For the small amount of sand mentioned it will not be profitable to install a large, elaborate or expensive separating apparatus and it may not be necessary to install any if the sand can be delivered immediately at the filter and if the engineer of the filter will permit the use of the filter itself for grading the sand.

As sand filters are washed at very frequent intervals by a reverse current of water going upward through the sand bed and carrying off in suspension the sediment and fine materials collected there, the same process may properly be applied for the grading of fine sand for use in the filter bed and for the removal from it of earthy matter and portions of the sand that are too small for the requirements. This method does not in any way threaten damage to the filter and as the work may be performed quickly it should not under ordinary conditions be objectionable. It has been employed for removing from operating filters sand therein finer than was desired.

If the particles that are too coarse have already been separated from the sand, the remainder may be placed on top of the sand already in position in the filter bed and the washing water turned on from below will pass through it and float away the particles that are too fine, which should be carried off through the overflow gutters, leaving only the larger, acceptable grains, in position in the filter bed, where, if they form too thick a layer, a portion can be removed and stored and the remainder left in position for immediate service. The size of grains remaining can be closely governed by adjusting the pressure of the washing water so that the velocity of the overflow conforms to that required to hold in suspension all particles lighter, and consequently smaller, than the required grains.

These operations are easily and rapidly performed, will not keep the filter long out of service, and are probably the cheapest and simplest method of grading a small quantity of fine sand.

GRADING BY HOPPER

If the filter washing method is not available, a few hundred yards of sand can easily be graded, wherever it is stored, by means of an overflow hopper and a supply of running water under a pressure of 10 pounds or more.

For a small amount of sand with water at a moderate pressure the apparatus indicated in the sketch will be found convenient, cheap and efficient. A pyramidal wooden hopper about 3 feet square at the top is firmly supported at a convenient height above the ground and is provided with a water supply through a valve on a 2-inch pipe with its outlet at the apex at the bottom of the hopper.

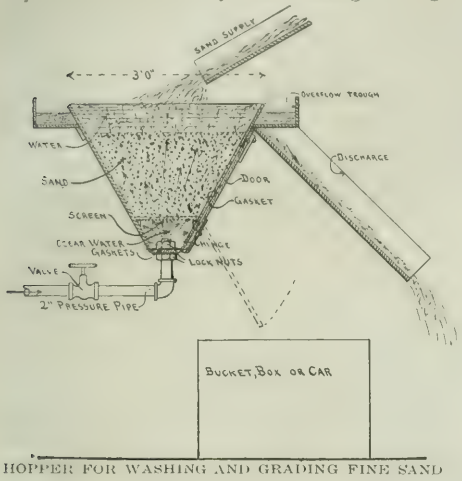
A few inches above the bottom of the hopper there should be placed a removable horizontal screen with a mesh of about the size of the required sand grains, to serve as a barrier to prevent the sand from reaching the open outlet of the pipe and also to act as a distributor spreading the upward flow of the water over a larger area and leaving below it a pressure chamber filled with clear water.

A large opening covering most of one side of the hopper should be closed by a door hinged at the bottom and provided with a gasket that

should be attached to the sides of the hopper, enclosing all sides of the opening. The gasket may be satisfactorily made of a small rubber pipe engaging shallow grooves in the exterior of the hopper and in the interior of the door.

The top of the hopper should be surrounded on all sides by a trough a few inches wide and deep connected at any convenient point with an outlet trough or spout to discharge the overflow water and waste material.

Sand is shoveled by hand into the hopper or may be delivered to it by water carriage through



HOPPER FOR WASHING AND GRADING FINE SAND

a trough or inclined chute which may, if desired, be provided with cleats or baffle boards across the bottom to retain pebbles or large grains of sand the size of which would be determined by the inclination of the chute and the amount of water used.

FINE GRAINS FLOATED AWAY

While the hopper is filling with sand, water should be entering from the bottom, filling the hopper and overflowing equally on all sides into the trough. The sand should continue to enter the hopper until within three or four inches of the upper edge, the water rising through it, meantime separating out the earth, loam and smallest grains of sand, holding them in suspension and carrying them over the edge to the trough.

By adjusting the valve, the amount of water and the velocity of flow through the sand can be regulated accurately so as to carry with it larger and larger grains of sand as the flow increases. It should be carefully watched and tested until it is regulated to carry away all materials less than 0.25 millimeter in diameter.

When the overflow runs free and clear the valves should be closed and the door in the side of the hopper opened and lowered to the inclined position, forming a chute over which the sand can be discharged to a car, bucket, or box provided to receive it. The door is then closed and the operations repeated over and over again. The hopper can be filled and emptied rapidly by one man, who can grade many yards per day.

SEPARATION OF COARSE GRAINS

If it is found that there is too much coarse sand, it can easily be removed by passing the washed sand through the hopper a second time and on this occasion increasing the pressure and velocity of the waters sufficiently to carry over in the overflow all of the sand that is 0.25 millimeters in diameter and smaller than the minimum size of rejects. This sand, instead of being wasted by the overflow, should be collected and saved and the larger grains of sand remaining in the hopper will be available for any other purpose.

As this operation depends entirely upon the amount of material removed by the water at different velocities it can be easily regulated and accurate results obtained with rapidity by the adjustment of the valves to control the flow of water.

The apparatus here described may be modified in various ways to suit the nature of the sand, the amount required and various other conditions.

A more elaborate sand washing hopper is described on page 85 of the third edition of "Water Supply Engineering," A. P. Folwell. In this case the hopper is made of cast iron and is provided at the bottom with an ejector for removing the graded sand by water pressure.

AMOUNT OF WATER

The amount of water required for grading the sand may be found approximately by the formula

$$W = \frac{A\ D}{0.0195}$$

where W is the amount of water in gallons per minute, D is the diameter of the required sand grains in millimeters, and A is the area of the top of the box in square feet. Substituting and reducing we have

$$W = \frac{9 \times 0.25}{0.0195} = 115$$

Federal Aid Appropriation Postponed

Although strenuous efforts were made to put through a $100,000,000 appropriation for good roads in the present session of Congress this has been found impossible, but it seems almost certain that a bill appropriating this amount will be passed by the middle of the summer. The bill was added as a rider to the post office appropriation bill and it was partly for this reason that it was defeated. Senator Townsend, chairman of the post office committee, was in favor of a bill providing for interstate highways to be built by the government but there is apparently no chance of his getting such a bill through. However, it seems possible that he will secure modifications of the present regulations governing federal aid, the principal of these being that none of it shall be appropriated for dirt roads, but that only durable or paved roads shall be aided, and that there shall be more effective inspection of a road before federal money is paid out for it.

NEWS OF THE SOCIETIES

March 22—PHILADELPHIA, PA., SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Engineers' Club.

March 22—ATLANTA, GA., SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Carnegie Library, Atlanta.

March 22—BALTIMORE, MD., SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Engineers' Club.

March 23-24—AMERICAN WATER WORKS ASSOCIATION. Illinois Section. Annual meeting, Chicago, C. C. Habermeyer, Secretary, Urbana, Ill.

March 25 — KANSAS CITY SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Northeast Power House of Kansas City Light & Power Co.,

March 25—SAN FRANCISCO SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Substation of United R. R. of San Francisco.

March 25—COLORADO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Metropole Hotel, Denver.

March 25—METROPOLITAN SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Engineering Society Building, New York City.

March 30—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Directors' meeting. Atlanta, Ga. Secretary, James T. Mulcahey, Yonkers, N. Y.

April 1 — VANCOUVER SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

April 11 — HARTFORD SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. City Club, Hartford, Conn.

April 14—SAN FRANCISCO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

April 15 — MERIDEN SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

April 16—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Joint meeting with the Association of Iron and Steel Electrical Engineers. Pittsburgh, Pa.

April 18-23 — UNITED STATES GOOD ROADS ASSOCIATION. Greensboro, N. C.

April 21-22—BANKHEAD NATIONAL HIGHWAY ASSOCIATION. 5th annual convention. Greensboro, N. C. Secretary, J. A. Routree, Birmingham, Ala.

April 22 — REGIONAL MEETING, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting of Atlanta, Birmingham, New Orleans sections. A. S. M. E. Council to attend. Mobile, Ala.

April 22 — METROPOLITAN SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with American Institute of Electrical Engineers.

April 22—BIRMINGHAM SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with Atlanta, Birmingham and New Orleans sections, with members of Council present. Battle House, Mobile, Ala.

April 27—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention. Houston, Texas.

April 27-29—UNITED STATES CHAMBER OF COMMERCE. 9th annual meetin Atlantic City, N. J.

April 27-29 — BUILDING OFFICIALS CONFERENCE. Seventh annual meeting Cleveland, Ohio.

April 28-29 MID-CONTINENT SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting of Chemical Eng. Societies. City Auditorium or Convention Hall, Tulsa, Okla.

April 29 — EASTERN NEW YORK SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Edison Club Hall, Schenectady.

April 29 — COLORADO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Metropole Hotel.

May 2-4—MISSISSIPPI VALLEY ASSOCIATION. 3d annual convention. New Orleans, La.

TRADE CONFERENCE. 8th convention.

May 4-7—NATIONAL FOREIGN TRADE CONVENTION. Cleveland, Ohio.

May 9-11—AMERICAN ASSOCIATION OF ENGINEERS. 7th annual convention. Buffalo

May 9-12—SOUNTHWEST WATER WORKS ASSOCIATION. Shirvin Hotel Headquarters, Oklahoma City, Okla.

May 9-12 — SOUTH-WEST WATER WORKS ASSOCIATION. Oklahoma City. Headquarters Skirvin Hotel

May 17-19—NATIONAL FIREMEN'S ASSOCIATION. Twenty-third annual convention. Fort Wayne ,Ind.

May 19 — SAN FRANCISCO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

May 20 — AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. 376th meeting. Engineering Societies Building, New York City.

May 23-26 — AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Spring meeting. Congress Hotel, Chicago.

June—CONFERENCE OF MAYORS AND OTHER CITY OFFICIALS, State of N. Y. 12th Annual Conference, Elmira, N. Y.

June 6-10—AMERICAN WATER TER WORKS ASSOCIATION. Annual convention at Cleveland, Ohio. Secretary, J. M. Diven, 153 West 71st St. New York

June 7-9—NATIONAL FIRE PROTECTION ASSOCIATION. Annual meeting. San Francisco, Cal.

June 21-24 — AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual and Pacific Coast Convention. Salt Lake City.

ENGINEERING COUNCIL PETITIONS PRESIDENT HARDING

The American Engineering Council of the Federated American Engineering Societies has sent to President Harding a communication asking that an engineer be appointed Assistant Secretary of War. Another communication requested Mr. Harding to name an engineer for the vacancy on the Interstate Commerce Commission. Both communications were authorized by vote of the Executive Board of the council, of which Herbert Hoover is president, and which represents 150,000 American engineers.

The council is now conducting an active campaign to reorganize the United States Patent Office. The establishment of a National Department of Public Works is another aim of the engineers. The appeal to Mr. Harding to select an engineer as Assistant Secretary of War states that this position is one requiring "very special qualifications, a large part of which are concerned with engineering." The appointee must possess technical knowledge and executive ability and must be familiar with cost of construction and operation as well as having experience with various types of employees. The engineers are furthering the interests of no individual or group, but desire only to serve the nation by improving its administrative departments.

NATIONAL FEDERATION OF CONSTRUCTION INDUSTRIES

At the Chicago convention March 2 and 3 resolutions were passed urging manufacturers, producers, and distributors of builders' materials to make further reductions, establish reliable permanent prices and publish the reasons why certain increases were necessary above pre-war rates; urging contractors, builders, employers and others to create the basis of labor cost conforming with present conditions and requirements for the re-establishment of industry, readjusting wages and eliminating labor instability so as to secure maximum production and minimum expenses; urging financial interests to make maximum loans for building construction; urging transportation companies to eliminate all inefficiency in operation and to reduce expenses to a minimum; urging coal mine owners and operators to improve methods of mining and marketing, eliminate waste, and secure maximum efficiency with labor rates in accordance with present conditions, thus reducing the cost of fuel.

The federal, state, and municipal governments are urged to eliminate all unnecessary expense and reduce the tax burden; all organizations and individuals connected with construction are urged not to enter into any agreement that can tend to the injury of the public or to unnecessary increase of the cost of construction. The conference called for the appointment of a Central Direction Committee to contain representatives of the elements entering into the construction industry who shall prepare a plan for local conferences throughout the United States, cooperate with construction industries and take other action to promote the revival of construction activities. The conference also sent a telegram to President Harding appreciating his endorsement and offering him full and complete co-operation.

HARTFORD SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS

A joint meeting of the Hartford section of the A. S. M. E. with the Connecticut Valley section of the American Chemical Society will be held at the City Club, Hartford, on April 11. Members of all national societies are invited, and the subject will be the "Corrosion of Metal Surfaces."

SOUTHWEST WATER WORKS ASSOCIATION

The convention of the Southwest Water Works Association, to be held at the Skirvin Hotel, Oklahoma City, Okla., on May 9 to 12, inclusive, is expected to be a very successful one. A large attendance is anticipated and papers will be presented from the State Board of Health of different states.

WYOMING ENGINEERING SOCIETY

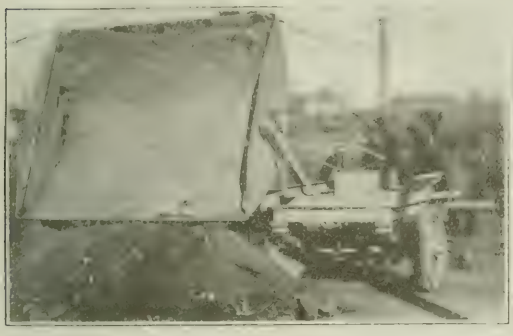
The Wyoming Engineering Society at a recent meeting elected the following officers for the coming year: President, Ambrose Hemingway; vice-president, James Wisda; and secretary-treasurer, Henry Watson.

SEATTLE SECTION, AMERICAN SOCIETY OF CIVIL ENGINEERS

The following officers were elected at a meeting held on January 31 of the Seattle section, American Society of Civil Engineers: President, T. E. Phipps; vice-president, Bertram D. Dean; and secretary-treasurer, Frank H. Fowler.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



SHOWING COMPLETE DISCHARGE OF LOAD, BODY CLEANING DUMPAGE, AND TEAM AT RIGHT ANGLES TO TRAILER

STEERING BAR WITH LONG LEVERAGE CONNECTED TO EXTREME FRONT END OF DRAWBAR

WARREN HEAVY DUTY TRUCK TRAILERS

The Warren Manufacturing Copmany has completed arrangements for the production of a new type heavy 2, 3 and 5-ton 4-wheel truck trailers that have been experimented with and tested for more than two years and are protected by a number of patents.

The proper tracking of the trailers with the trucks has been solved by providing a steering arrangement with long leverage that guarantees complete control and eliminates any possibility of deviation from the arc of the truck.

Radical changes from former practice provide for an attachment from the steering arrangement to the draw-bar when the trailer moves forward and with the axle in a locked central position when the trailer is backed, thus eliminating the possibility of kniting the draw-bar when the trailer gets into a cramped position.

When the trailer is backed the front wheels are locked parallel to the frame and the draw-bar is disconnected from the steering gear and is free to swing to either side while the trailer is guided by an auxiliary steering gear applied to its rear end.

SHOWING STEERING BAR ENGAGED TO AXLE, TYING FRONT WHEELS FOR BACKING UP

In extreme cases, as for making very small circles, both sets of trailer wheels can be clamped at any angle, thus permitting the movement of the trailer around any obstacle.

The Warren principle of ball and socket joint connections is applied to the steering gear attachment which has been made fool-proof and can easily be used on old models of trailers as well as new ones. With it, it is believed that all objections to the use of 4-wheel trailers has been removed.

The principal advantages claimed for the new two-way dump body offered with trailers are its low price; durability; facility for handling municipal ashes, rubbish and garbage; its interchangeability with other bodies on the same trailer; simple construction; short turning radius of the trailer; clearance of body over dumpage; constant control of body by cables; light weight making it possible to haul trailer by tractor, truck, horses or mules and quick operation, enabling the body to dump and to be returned by gravity to horizontal position in 50 seconds.

CIVIL ENGINEERS' SUPPLIES

Engineers and surveyors will be interested in a 40-page catalog of field and office supplies just issued by the C. F. Pease Co. This book lists drawing, profile and cross-section papers, tracing cloths, blueprint papers and

SHOWING STEERING KNUCKLE AXLE AND STEERING ARMS CONTROLLED BY TIE ROD, DRAG LINK AND STEERING ARM.

LOADING EDGE 60 INCHES FROM GROUND ONLY

BITOSLAG PAVING ON LINCOLN HIGHWAY, NEW CASTLE COUNTY, DELAWARE

MANHOLE TOP AND COVER

blueprinting machines, drafting room furniture and such field supplies as transits, levels, ranging poles, leveling rods, etc. Prices and descriptions of each article are given and the book is very fully illustrated.

BITOSLAG PAVEMENT

Bitoslag paving material is a mixture of general aggregate, preferably slag, a filler and asphalt, known as bitocement. It is recommended for its homogeneity, density and wearing qualities, suited to resist heavy traffic. It is impervious to moisture and unaffected by temperature changes, is very durable and has rigidity sufficient to withstand traffic strain, with enough malleability to prevent chipping and breaking. The blast furnace slag used is very hard and has great tensile strength. Its fracture is irregular, providing for very intimate bond between it and the special bitocement binder, which possesses great rigidity and toughness.

The bitoslag paving mixture may be laid on concrete base, old macadam, old brick pavement, or any other suitable foundation over which the mixture of general aggregate, lime and bitocement is spread and rolled, forming a dense and durable wearing course that is watertight and extremely tough. Bitoslag mixture is manufactured in regular asphalt paving plants and any plant of standard make is capable of producing it.

EARTH CRETE

"Earthcrete," a road material manufactured by the Earth Concrete Company, is used to promote the utilization of earthy material found alongside the right-of-way in order to effect a saving in crushed rock, sand and gravel required in the road bed.

In use it is recommended to dissolve 4 ounces of earthcrete in the water used for one sack of cement, which is combined with five parts of clay, sand, gumbo or other soil free from vegetable matter, and thoroughly wet and mixed like mortar or concrete. It is recommended as a foundation for asphalt, brick and other paving surfaces and is reported to offer good resistance to weather and traffic.

UNIVERSAL BARS

Universal bars for corner protection and joint protection in concrete construction are sold by the Universal Concrete Bar Company and are used to protect straight and curved curbs, to protect exposed corners in general concrete construction, and to provide for construction joints in roads, pavements, walls, buildings and other places. They are adapted to longitudinal and transverse joints and are easily installed, self-sustained, self-anchoring, durable, strong, and economical.

They are made from 2½ x 1½ x 3/16-inch soft angles, weighing about 2½ pounds per foot and having in one flange lugs sheared down 6 inches apart to penetrate and anchor with the concrete. The full and standard lengths are 14 feet, 16 feet and 18 feet and to any practicable specified length.

GIANT CONCRETE MIXERS

Giant concrete mixers made by the Judy Manufacturing Company are recommended for general construction work and for concrete road work. They are mounted on trucks, have a powerful engine enclosed in steel housing and are equipped with either barrow, batch or power loading hoppers. They are made with a capacity for 4, 7 or 10 cubic feet of mixed concrete, and can be operated either by gasoline, A. C. or D. C. motors, or steam engines.

The advantages claimed include chilled drum rollers, adjustable roller bearing journals, over-size capacity non-slipping drums, self-aligning ball bearings for the power loading hoist, easy discharge and rapid mixing.

STRAINER CAP

The catalog contains specifications, illustrations of special parts, and various convenient tables of quantities and cost of different materials and of concrete for various kinds of work.

CONCRETE MIXER WITH NON-SLIPPING DRUM

MUNICIPAL CASTINGS

H. W. Clark Company has issued a folder illustrating Clark municipal and special castings of quality, including many different types and varieties of manhole tops and covers for sewer and water works, gratings, catch basin inlets, curb castings, doors, frames, floor plates, grate bars and other items. Correspondence is solicited and officials are invited to send sketch and measurements on which estimates will be promptly furnished.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879

Vol. 50 FLORAL PARK, MARCH 26, 1921 No. 13

Sewage Treatment at Lexington

Grit chambers, Imhoff tanks, sludge beds, dosing tanks, sprinkling filters and secondary tanks. Inverted siphon under railroad tracks. Methods and cost of operation.

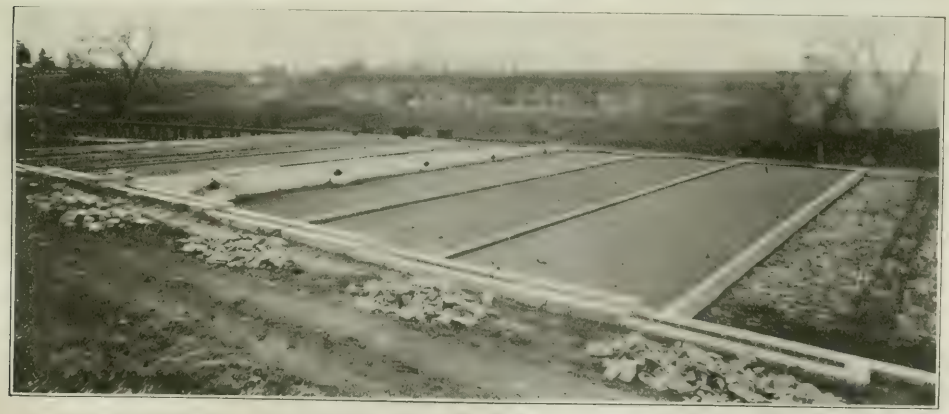
The house sewage of Lexington, Ky., is collected by a system divided into three main units, known as the southern, central and northern. These serve approximately 3,500 acres containing a population of 45,000 and carry an average daily flow of 3,000,000 gallons. The general flow is westward and the three units combine in a 39-inch outfall sewer at the western city limits. This outfall sewer is 5,300 feet long and has a uniform grade of 1.3 feet in 1,000.

At the end of this outfall sewer is a sewage treatment plant which was built about three years ago. It is located on the city farm about a mile west of the town, which farm also contains the city jail and the city rock crushing plant. The sewage plant is located on the bank of a creek and the elevation of the end of the outfall sewer here is 26 feet above the creek.

The plant is about 200 feet south of and 10 feet higher than the tracks of the L. & N. Railroad. As the outfall crosses these tracks it was necessary to pass under them by use of an inverted siphon. This siphon is constructed of two 18-inch cast-iron pipe which can be operated separately or together. A few feet south of the tracks the siphon pipes rise vertically and discharge into an open channel constructed of concrete which is 15 feet above the surface, the channel being 4 feet deep and 3 feet wide and 350 feet long. The siphon pipes continue at the grade of their lowest level to form a blow-off into the creek for use in emergencies. Where they pass under the railroad tracks the bottoms of the pipes are 9 feet below the rail.

THE TREATMENT PLANT

The plant consists of grit chambers, Imhoff tanks, sludge beds, dosing tanks, filter beds and secondary tanks. There are three grit chambers constructed for operation separately or together; two Imhoff tanks each divided into two units, with two sludge chambers in each unit. There are two dosing tanks equipped with Miller flushing apparatus, each tank divided into two chambers, each chamber having a capacity for discharging about 11,000 gallons. The open channel passes an area provided for future settling tanks and



GENERAL VIEW OF SLUDGE BEDS

Portable track for sludge cars at extreme right. Trestle for sludge cars at left background.

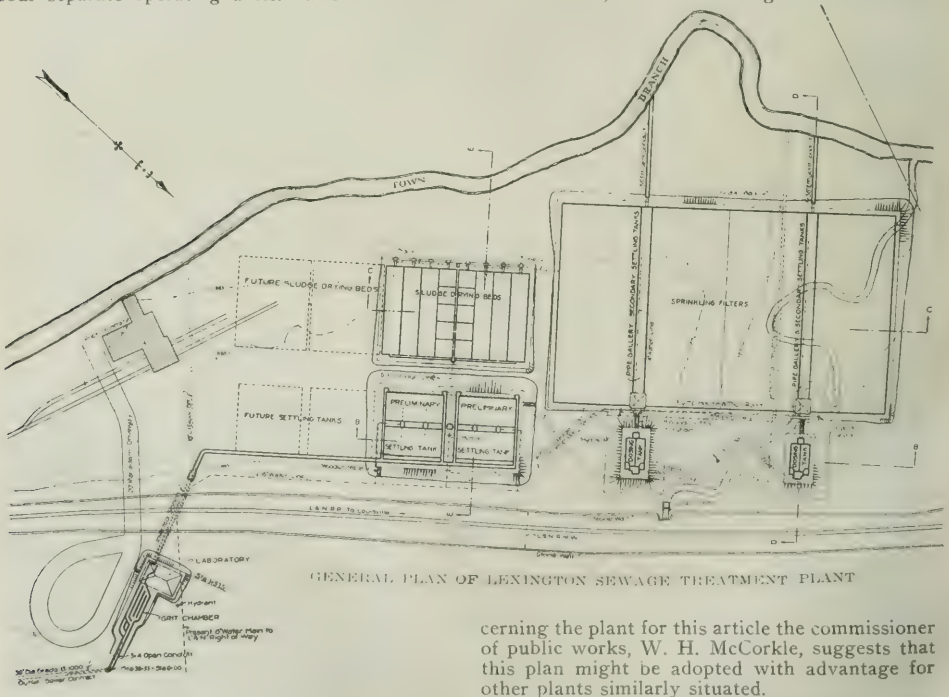
there is also area for additional sludge drying beds and sprinkling filters.

Just above the intake end of the inverted siphon are three grit chambers provided with screens and equipped with electrically operated pumps for cleaning them. Adjoining these and over the entrance to the inverted siphon is a laboratory used for controlling the operation of the plant. The screen just ahead of the grit chambers is constructed of ⅜-inch by 2-inch bars 8 feet long spaced two inches apart, making an angle of about 30 degrees with the horizontal. Each grit chamber contains in the bottom a basin depressed 15 inches below the bottom of the outlet and 25 to 30 feet long. Below the bottom of this depression is a further depression filled with graded broken stone covering a line of 6-inch open-joint drain pipe, the center of which is 15 inches below the bottom of the depressed channel.

The Imhoff tanks are placed with their direction of flow parallel to the inlet channel. From this channel a branch inlet passes down each end of the tanks so as to provide for reversing the direction of the flow.

The filter beds contain two acres divided into four separate operating units. The filter material is six feet deep, four of these being crushed native limestone and the two upper feet being crushed Georgia granite. In constructing the filter beds the city was confronted with the alternative of using local limestone or paying about 60 per cent more for granite for the filtering material. It was finally decided to use the local limestone for the lower two-thirds of the material and the imported granite for the upper one-third. This kept the limestone beyond the action of freezing and of the air, and in furnishing information concerning the plant for this article the commissioner of public works, W. H. McCorkle, suggests that this plan might be adopted with advantage for other plants similarly situated.

OUTFALL SEWER AND GRIT CHAMBERS
Screen just above grit chambers. By-pass at left. Laboratory building in rear. City stone crusher at left rear.



GENERAL PLAN OF LEXINGTON SEWAGE TREATMENT PLANT

The filter nozzles (which are of the Taylor design) are mounted on rising pipes of two-inch galvanized iron, these rising pipes or nipples being screwed into bosses in the main distributor pipes, which pipes are imbedded in the stone with their axis 9 inches below the surface of the filter, the orifice of the nozzle being 4 inches above the

filter surface. The main distributors are from 20-inch to 12-inch, while the lateral distributors are 6-inch "universal" pipe. The underdrainage system consists of 6-inch half tile completely covering the bottom of the filter.

The only pumping required is an electrically operated sludge pump for removing the sludge collecting in the secondary settling tanks, which tanks are located between the sprinkling filters and under the pipe gallery, each tank being about 220 feet long and 10 feet wide and divided into 16 hopper bottoms, each with its suction pipe resting on an open footing for removing the sludge. Each hopper bottom is 10 feet square at the top and 8 feet deep. The sludge from the settling tanks is pumped back into the Imhoff tanks, while the effluent passes into the creek.

The sludge bed area is made up of six separate beds each 20 feet by 105 feet. A 24-inch gage railway runs down the middle of each bed to a main track just outside the ends of the beds, there being a turntable at the junction of each branch with the main. This main track is continued beyond the beds onto a low trestle to facilitate dumping the sludge into carts for hauling away.

CONCRETE CHANNEL LEADING TO SETTLING TANKS
Inverted siphon, after passing under tracks, discharges into channel at the left end. Valves of settling tanks are seen at the right.

OPERATION OF PLANT

The Lexington plant is perhaps as efficient a one in its operation as any in the country, and employs the most up-to-date appliances which have been proved to be effective. By passing under one railroad by an inverted siphon it is possible to reach the plant with sufficient head above the creek to avoid pumping. Very little labor is necessary for its operation and for the upkeep of the grounds, which the city is endeavoring to make attractive by shrubbery and other planting.

During the two years and six months of operation the upkeep of the plant has consisted of cleaning the grit chambers once a month, skimming and cleaning the surface of the Imhoff tanks about three times a week, cleaning the secondary hoppers about three times a year, removing the sludge at intervals averaging about one bed a week, and hauling away and scattering about half the sludge, the other half being taken by farmers.

The annual cost of upkeep and maintenance of the plant and grounds is as follows:

Superintendent	$1,800
Chemist	900
Watchman	780
Power, light and water	216
Telephone	53
Team, wagon and incidentals	500
Total	$4,249

In addition, two laborers from the prison are employed for which no charge is made and which are not included in the cost above.

An excellent feature of the plant, which is omitted from some plants apparently from oversight and from others because of the absence of any water supply in the vicinity, is a complete system of water supply with connections for attaching a hose at every part of the plant. This permits of easy and convenient cleaning and washing down of the walls, breaking down scum in the Imhoff tanks, loosening sludge and other purposes.

In breaking down the scum on the surface of the tanks about every three days, the surface is first sprinkled to settle as much of the scum as possible and that which does not settle is then skimmed off and thrown into the gas vents, this skimmed material usual-

IMHOFF SETTLING TANKS IN SERVICE
On chimney in foreground may be seen water pipe. In chimney is seen scum nearly to the top.

ly consisting of corks, matches and other light floating matters. The only reason for cleaning the surface of the tanks as often as this is that of cleanliness and appearance and to provide better opportunity for air action.

Each discharge of 11,000 gallons from a chamber of the dosing tanks is distributed over one acre, and the discharges occur, on an average, seven times an hour and continue for two minutes, no sewage being sprinkled over the bed during the remainder of each interval.

The nozzles on the sprinkling filter do not clog readily and are easily removed and cleaned. One man working for four hours a week can keep clean the nozzles of two acres of filter and maintain satisfactory operation. He goes over the beds about twice a week, removing and cleaning all sprinkler heads that are not perfectly free of stopage.

Up to date about 50 per cent of the sludge has been removed by farmers. The farmer can drive his wagon under or alongside of the trestle leading from the sludge bed and the sludge cars run onto the trestle can be dumped directly into his wagon. The sludge not so removed has been used for fertilizing the city farm and the area around the plant. The results reported by different farmers and the superintendent of the plant show that the crops of corn, tobacco, oats and potatoes fertilized by the sludge are much superior in yield and in quality to those grown on land not so fertilized. So far these are the only crops that have been fertilized by sludge. The farmers using the sludge fork it onto the land directly from the wagons in which they receive it at the plant. The farm contains a number of quarry sites which can be filled with sludge and which are estimated to have capacity for receiving sludge for sixty years to come. The city works these quarries and one of the illustrations shows the city rock crusher and stone bins.

Kansas City Water Supply

A report on improvement and extension of the water supply of Kansas City, Mo., was presented to the Board of Fire and Water Commissioners of that city on December 31st last. It recommended construction estimated to cost $18,000,000 based on 1920 prices (although on a pre-war basis the cost would probably have been less than half of this), and that a commission be appointed for carrying out the work as has been done in New York, Cincinnati and elsewhere.

On February 21st the mayor appointed a committee of 25 men and women representing every phase of business and civic life in Kansas City as a committee to work out details of the procedure for securing the new water supply. The main problems presented for its solution were the character of the bonds to be issued, the amount of bonds, the rate of interest which they should bear, the charter amendments which would be necessary and the holding of a bond election. The first meeting of the committee was held the day following. Previous to this a committee of four had been named at a joint meeting of the civic organizations which was responsible for the appointment of the committee of 25, and the latter committee requested the committee of four to draft a plan of organization and appoint from its membership subcommittees to investigate the various phases of the subject.

This plan seems to give every opportunity for carrying on the work with the full confidence of the public and so far politics has apparently played no part in these appointments.

The consulting engineers are Fuller & McClintock, and they state that the water supply condition of the city is serious in that it is already nearly at the limit of its present supply, while it would require 4 or 5 years and possibly 6 to build the new supply. Meantime it will be necessary to impress upon all citizens the need of conserving supply and cutting down consumption to a minimum.

Details of the recommendations of the consulting engineers will be given later.

Some Recent Highway Costs

Several of the states have already received bids for highway construction, although the number is not so great as was hoped for so late in the spring as this. The State Highway Commissioner of Pennsylvania has announced that all bids received by him were too high and should be rejected, and a few days later the Illinois Division of Highways made a similar announcement. Bids were received by Massachusetts on March 1st for two concrete roads and a bituminous macadam road. In the former the chief item was of course the concrete and the bids on this ranged from $15.00 to $16.25 per cubic yard for the concrete surface, the amount of such surface being 4,250 cubic yards in one case and 2,310 cubic yards in the other. This indicates close bidding. Two of the firms bid on both contracts, one bidding 50 cents more on the second than on the first and the other bidding 92 cents higher on the second contract.

The surface material of the bituminous macadam road comprised 2670 tons of broken stone and 23,550 gallons of bituminous material. The bids for the broken stone were $5.00, $5.10 and $5.50 by the three bidders and for the bituminous material were 35 cents, 25 cents and 29 cents, respectively.

In Wisconsin, bids had been received for two dirt roads and one with alternative bids on concrete and bituminous macadam. In the case of the earth roads the largest items were of course earth excavation and embankments, and as the details are not known, the reasonableness of the prices cannot be judged. However, the bids for earth excavation on one contract ranged from 60 cents to 72 cents, and on the other from 65 cents to 85 cents. In each of these the contract was awarded to the lowest bidder. In the case of the surfaced road, 18-foot concrete surfacing bids varied from $2.43 to $2.83, and for 18-foot bituminous macadam two bids were received for $2.79 and $2.85, respectively. Of the two contractors bidding on both surfaces, one bid a total of $123,116 on concrete and $102,461 on bituminous macadam, the other bid $137,153 on concrete and $104,229 on bituminous macadam.

At Lebanon, Pa., on March 3d, a bid was let for

concrete at $16.50 a cubic yard; or $3.07 per square yard including excavation of old macadam and pavement 6 inches thick mixed 1:1½:3 and with 25 pounds of mesh reinforcement per 100 square feet. Also one for bitulithic on a 5-inch concrete base mixed 1:3:6 and excavation of old concrete for $3.82 a square yard, the concrete being $11.90 a cubic yard and the bitulithic $1.75 a square yard.

Lowering Water Main with Trench Machine

The water department of Springfield, Mass., last year lowered a 30-inch water main 12 to 18 inches for a length of about 700 feet in St. James boulevard because of a change made in the grade of the street since the pipe was laid. In this work it used a Parsons trench machine. This excavator was used to dig a trench 2 feet wide on one side of the pipe and down to a depth to which the pipe was to be lowered. At the same time 6 men with shovels excavated a trench to similar depth on the other side of the pipe, throwing the dirt over into the buckets of the excavator. The men also removed the earth from under the pipe, except that columns were left to support it at intervals of a few feet. With the entire length in this condition, the men gradually reduced the size of these earth columns, permitting the pipe to lower gradually, which it did without assistance owing to the weight of the pipe and contained water. The entire work was finished in a day and a half and the trench was refilled in a short time afterward by the use of a backfiller. H. M. King, assistant superintendent of the water department, said that it would have required 40 to 50 men to have done the work entirely by hand labor.

This excavator was put into service by the department last May and first laid a mile of 16-inch pipe, followed by removal of a half mile of 6-inch pipe and the laying of 2 miles of 8-inch. In laying pipe with this trencher a gang of 8 to 12 men is used, most of them for rolling the pipe, lowering it into the trench, digging bell holes, etc. About 35 men are ordinarily employed for similar work where the machine is not used.

An Automatic Release Sling

For the construction of storage reservoirs on the Yakima projects, Washington, bundles of round timber are dragged along the surface of the ground by a cable operated by a hoisting engine and attached to a wire rope sling passed around the bundle of logs.

The sling has a loop at each end and is fitted with an automatic releasing device that enables it to free itself when the tension is released and then to be hauled out from under the logs by the hoisting engine pulling in the slack of the main cable.

A snatch block that has a hook attached, engages the sling rope and is free to move from end to end of it but cannot pass over the loops at both ends. In service one loop of the sling is attached to the hook on the end of the hauling cable and the other end is passed around the bundle of logs and the loop on it engages the hook on the snatch block forming an adjustible loop or bight that encircles the logs. Winding up on the drum of the hoisting engine tightens the hauling cable, pulls the bight up snug against the timber and holds it there while the timber is dragged to position.

When the hauling rope is slacked off the spring in the sling rope throws it out of engagement with the hook on the hauling rope and when the latter is dragged back by the tail line attached to its main hook another short line attached to this hook and also attached to the hook on the snatch block, pulls the latter and the sling rope free of the logs and returns it to the hoisting engine.

This device enables a large strain to be put on the sling rope to release it and saves much time and trouble otherwise necessary for freeing the rope by hand. A similar arrangement might often be devised for detaching sling ropes in inaccessible positions or under difficult conditions for various kinds of construction operations.

Water Meter Maintenance

Itemized costs of reading and upkeep in Terre Haute.

In a round table discussion on the subject of water meters held by the Indiana Sanitary and Water Supply Association, Dow R. Gwinn, president of the Terre Haute Water Works Co., described the methods employed by his company, among them the following:

All meters are read monthly and bills rendered covering that period. The cost of repairing, testing and maintaining meters during the previous year was $522.61 for material and $1,721 for labor; 7,700 meters were in use, giving the average cost per meter in use as about .29 cents.

The expense on consumers' premises consisted of $304.25 for inspecting plumbing, $935.91 for investigating large bills and services, $2,694.62 for turning off and on, $20.20 for changing meters for testing, $479.45 for removing and setting meters; an average of 56 cents per meter.

The cost of reading meters was $2,600, an average of 34 cents per meter per year or a little less than 3 cents per month. The cost of delivering bills averaged 16.6 cents per customer per year, or 1.4 cents per month. The cost of office and clerks making out bills, receiving payments, etc., averaged 69 cents per consumer. The cost of repairing leaks and changing service connections from main to curb was $546 for material and $711 for labor, an average cost of 15.9 cents per service.

This gives a total of about $2.20 per meter per year for cost of maintenance and repairs of meters and services. Ninety-seven per cent of the services are metered and the minimum monthly rate for ⅝-inch meters was 75 cents, for which the consumer is allowed 3,000 gallons during the month. Omitting industrial and railroad consumers, the average payment per month was $1.27. The company is required to furnish and maintain the service pipe from the main to the curb and also to furnish and maintain the meter. Mr. Gwinn maintained that with such low bills

it is impossible for water works to make any profit under present conditions.

He stated that the experience of his company was that large meters should be tested once every year and that the saving to the company in correcting slow meters will far offset the cost of overhauling and testing. All large meters appear to run a little slow after having been in service for a year, most of them 5 to 10 per cent and some as high as 15 per cent. Smaller meters, 5/8-inch and 3/4-inch, should be tested about once in seven years. Every water department having 500 or more meters should be provided with a good meter testing outfit.

He believed that monthly reading of meters is advisable, even though the bills are rendered by-monthly or quarterly; his reason being that in this way leaks and excessive meter registration could be detected before the bill had become too large, and the consumer was less apt to feel that he was being cheated by the company if notified as soon as possible of the excessive consumption.

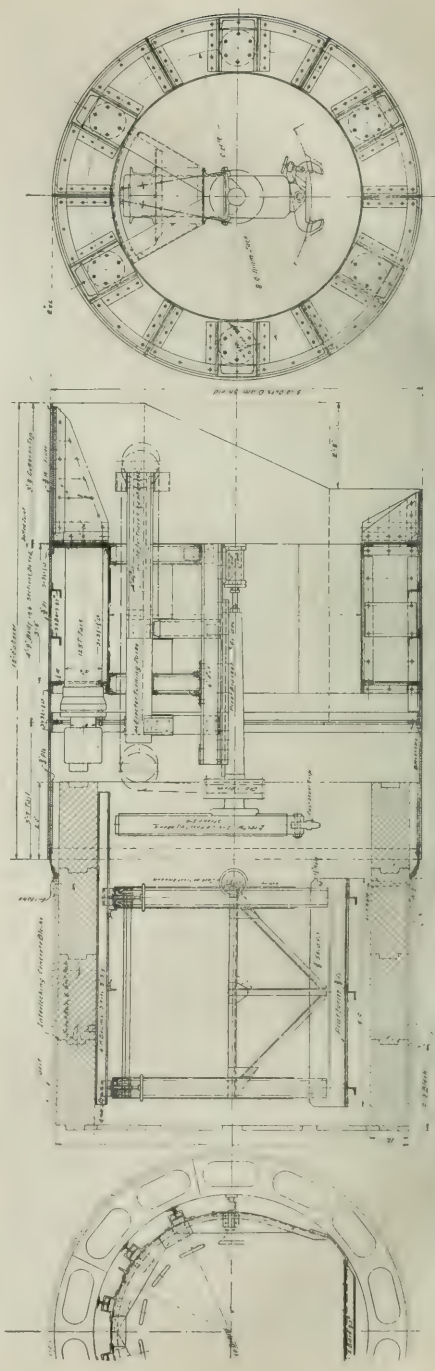
Linden Street Sewer Tunnel*

Method of shield excavation and driving, alignment and adjustment. Erection of concrete lining blocks. Adjustable supporting traveler. Backfilling behind shield tail. Grouting joints and backfill. Rapid progress and accuracy.

Construction operations were commenced by the installation of the contractor's surface plant and the sinking of one of the end shafts, about 30 feet deep. At the foot of this was installed the excavation shield 9 feet 10 inches in exterior diameter and 12 feet long over-all, which weighs about 13 tons and was built by the American Bridge Company. It is made with a 3/4-inch shell plate reinforced at both ends, and has a heavy annular vertical diaphragm located 3 feet 8 inches from the forward end and heavily braced to receive the thrust of the pushing jacks. A similar ring, perforated to receive and support the inner ends of the jack cylinders, is located 3 feet 8 inches behind the first ring and the inner flanges of both rings are connected by a cylindrical 1/2-inch plate forming the inner wall of the annular chamber in which the jacks are seated. The tail of the shield terminals with a flexible conical rubber and canvas apron 1/4 inch thick, that engages the exterior of the tunnel lining and forms a stop to exclude earth, sand and grit from the shield.

The shield has a clearance of 2 inches on all sides of the concrete lining. It is equipped with seven 125-ton hydraulic pushing jacks made by the Watson-Stillman Company. The jacks have

*Continued from page 219.



TUNNEL AT HEADING, SHOWING ARRANGEMENT AND DETAILS OF CONCRETE BLOCK LINING, EXTERIOR PACKING, SHIELD, JACKS, ERECTOR AND BLOCK ASSEMBLING TRAVELER

an 8-inch piston and 32-inch stroke, and are usually operated at 1,500 to 1,800 pounds pressure. They react against heavy oak cushion pieces placed on the face of the last erected ring of the lining blocks, and usually drive the shield forward 27 inches in about 5 minutes.

SEGMENTAL BLOCK ERECTOR

Suspended from the roof of the shield is a 3-ton erector for assembling the segmental roof blocks, which are about 4 feet long and weigh about 1,500 pounds each.

The erector, made by the Watson-Stillman Company, has a revolving radial arm carrying an adjustable grip that engages and is locked into the grip holes in each block and support it until it is in place. The erector has a rigid structural steel framework that carries the radial arm and the operating jack for revolving the arm and another for moving it longitudinally. The latter is of rectangular cross section made to fit the framework. The erector jacks, like those in the shield, are operated by a pressure pump on the surface which has a nominal capacity for 5,000 pounds pressure, only a fraction of which is required in this work.

An erection traveler follows immediately in the rear of the shield and supports the upper segment of each successive lining ring until the ring is completed, when the segments are self-supporting. It consists of a steel cradle and floor platform 6 feet long that takes bearing on the invert each side of the center line and has riveted to it a horseshoe shape steel transverse rib curved to a radius of 3 feet 3 inches. Each ring carries a jack at the springing line and at intermediate points, a total of eight screw jacks for the support and adjustment of six horizontal longitudinal I-beams, and two bearing castings for the support and adjustment of the segmental blocks.

The forward rib is located in the plane of the last completed ring of tunnel lining and the rear rib in the plane of the second ring in the rear or the third from the end, and the screws are set in the two ribs so as to force the I-beams into contact with the soffit of the lining, with the forward ends projecting far enough beyond the last assembled ring to afford complete support for the blocks as placed by the erector. This traveler is light and convenient, easily handled, affords very satisfactory support for the blocks, and permits passage through it to the shield and heading. It weighs about 3,000 pounds and was built by the American Bridge Company.

EXCAVATING, SHORING AND ERECTING

The excavation amounts to about 2.7 cubic yards per linear foot of tunnel and so far has consisted of about 90 per cent sharp sand and 10 per cent clay. The sand is all removed by hand by men working at a vertical face supported by horizontal breast boards braced back to the shield. Generally it will stand for a few inches of exposed vertical face, and at the top the excavation is made under the protection of thin poling boards about 6 inches wide and 2 feet long which are supported at the rear end on the cutting edge of the shield and at the forward end on vertical struts. In clay the excavation is made with mattocks. A small amount of water is encountered in the bottom of the tunnel which usually rises to a height of about 24 inches behind the dam formed by the muck shoveled back from the heading, and is removed in five minutes by a 3-inch centrifugal pump and a pulsometer just previous to the erection of a ring of segmental blocks.

As soon as the excavation has been completed for 2 feet 3 inches in advance of the shield, the latter is shoved forward in about 5 minutes by its jacks, the latter are retracted and the segmental blocks, brought in on flat cars on the 24-inch gauge service track laid on the tunnel invert, are assembled in position from the invert up by the erector, each block being located and interlocked with the preceding ring by the projections on the rear end that fit the recesses in the finished ring.

While the ring is being assembled, four men in the forward part of the shield excavate in advance and throw the muck back through the shield to a pile on the floor of the invert just in the rear of the traveler. From this pile it is shoveled into buckets and pushed by hand on flat cars to the foot of the shaft, where it is hoisted by a derrick and dumped to either of four elevated storage bins of 3 yards capacity that have double-flap hinged bottoms through which the contents of the bins are instantaneously discharged into trucks by which it is hauled about ¾ of a mile and dumped for fill on low ground.

PLACING THE GRIT PACKING

As soon as each successive ring has been completely assembled, short nipples are screwed into the grit holes in the intrados of the blocks. A 2-inch hose is connected to the nipples in the grit holes and they are first blown out with air at 80 pounds pressure, after which ⅛-inch washed and screened grit or gravel is forced through them under the same air pressure until no more can enter. The pipes are then shifted to other holes and the operation repeated.

Rods are then inserted through the grit holes and moved about to loosen the grit to enable the maximum amount to be forced in, and the hose connections are again made on these nipples, air is forced in and then more grit until the holes are filled solid. From 5 to 9 cubic feet of grit is required for each linear foot of tunnel. It is deposited in a substantially uniform layer about 3 inches thick all around the circumference of the concrete lining.

After the grit has been placed and the joints pointed up with cement mortar, grout under a pressure of about 80 pounds is forced into the joints and whatever voids there are outside the lining. The nipples are then removed and the threaded holes in the concrete blocks are pointed with cement mortar, as are the grip holes with which the blocks were handled by the erector.

ALIGNMENT ADJUSTMENT

The alignment of the tunnel is accomplished by means of six radial set screws inserted through the shield shell at equi-distant points below the spring line. These screws give 2-inch adjustment on all sides of the shield and are followed up by shim plates from ⅛ inch to ½ inch in thickness that give bearing for the segment blocks up to the spring

line and permit a deflection or correction up to 2 inches in any direction from the axis of the tunnel. They are very easily and quickly operated from the interior of the shield and enable the tunnel to be driven with such accuracy that the deviation from line or grade in 500 feet is less than ½ inch.

The work is carried on continuously by three 8-hour shifts, each of which averages three complete rings or 6 feet 9 inches progress, making a little more than 20 feet advance daily. During the month of December the tunnel was driven 184 feet notwithstanding the delays and interruptions incident to the installation of the plant and training the men to its operation. In January it was driven 390 feet and the week from January 28 to February 5 it was driven 116 feet. On February 6, when the notes for this article were taken, the tunnel had been driven 680 feet; subsequently it reached the foot of the intermediate shaft and the shield was revolved 90 degrees horizontally and pointed toward the second intermediate shaft.

The work is executed with a force of 16 men in each shift and an extra 9-man floating gang during the day shift.

Besides the equipment already mentioned, the plant installed includes one Ingersoll-Rand electric air compressor with a capacity of 350 cubic feet of free air per minute at 100 pounds pressure, one 25-gallon hydraulic pump with a capacity of 5,000 pounds pressure built by the Watson-Stillman Company, a derrick, and a two-drum Lidgerwood hoisting engine. The work is being executed under the direction of Innis O'Rourke, general superintendent, and Harry Redwood, superintendent in charge.

Municipal Partnership in Water Supply

Decatur, Ill., has partially effected an unusual business arrangement for increasing its water supply, entering into a partnership with a company organized for this especial purpose.

The city had planned to impound water in the Sangamon river by constructing a dam south of the city and the dam is now under construction. The city, however, had neither funds nor credit necessary for acquiring the lands that would be flooded by the dam or for the raising of bridges and altering of roads that would be required if a reservoir were formed in the river valley.

In this emergency an arrangement was evolved by which Decatur citizens have organized a "Water Supply Company" for the purpose of furnishing the necessary funds and otherwise assisting in securing for the city the facilities necessary for increasing its supply. An ordinance looking to the formation of a contract with this company was presented to the City Council on February 21st, but the arrangement could not be finally perfected by law until seventeen days later.

Under this arrangement the water company is to acquire in its own name the land which would be flooded, clear the land so as to be suitable for flooding, defend any suits and pay any judgments on account of backing up the water, and pay the cost of altering roads and bridges; the total expenditures not to exceed $1,000,000. The city agrees to pay the water company $35,000 on or before May 1, 1921, to complete the dam and intake and maintain same, and to pump the supply into and through the distribution system and sell it to consumers at reasonable rates, the rates collected to be for the joint account of the city and the water supply company. The sums accruing from rents are to be paid out only upon vouchers or warrants issued by officers of the city and company. The city will be paid each month its operating expenses for the previous month and the remainder will be divided between the company and the city in the proportion of 90 per cent to the company and 10 per cent to the city.

The contract is to run for 30 years, except that it can be terminated by the company on 30 days notice at any time after January 1, 1923, if the returns paid to the company during the previous year shall not have amounted to at least $135,000, unless the city shall pay the company the deficit within 30 days. If the contract is terminated or is for any reason declared void, the city must empty the reservoir and remove the dam or take such other action as may be necessary to return the river to its normal level. If the contract is declared void by courts, the company and city will continue an arrangement by 30-day periods, the city paying to the company 8 cents a thousand gallons on all water pumped, and these 30-day periods may be continued for not to exceed 30 years from the date of the contract.

At any time within this 30-year period the city can purchase the holdings of the company; the sum to be paid being sufficient to retire the outstanding obligations of the company, including its preferred stock, at its original par value, together with 7 per cent interest per annum on the outstanding capital stock from the date of its issue less any dividends already paid, and to pay the expenses of winding up the affairs of the company, including $1,000 to be distributed among the holders of the common stock; the company for this sum to turn over to the city, free of all liens, all its property and assets save a sufficient amount to pay its obligations and retire its capital stock.

Civic Tour to Europe

A tour is being planned to visit Europe next summer under the leadership of Dr. John Nolen, town and city planner, called a civic tour, with a view of studying the civic, economic and industrial conditions of England, Belgium, Germany, Austria, Italy and other countries. It will start June 7 and the party will break up in Paris on August 3 to return at the convenience of each individual. The rate from New York to the disbanding in Paris on August 3 will be $940, not including tips or any extras or passport expenses. Further information can be obtained from J. L. Crane, Robinson Hall, Harvard University, Cambridge, Mass.

Atlanta Votes $8,850,000 Improvement Bonds

Atlanta, Ga., early in March voted almost unanimously (21,710 to 513) for a bond issue of $8,850,000 for public improvements. Of this $4,000,000 is for schools, $2,850,000 for water works improvement, $1,250,000 for sewer extensions and $750,000 for a viaduct.

PUBLIC WORKS

Published Weekly
by
Municipal Journal and Engineer Inc
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates

United States and Possessions, Mexico and Cuba.....$3.00 per year
All other countries .....$4.00 per year

Change of Address

Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

CONTENTS

SEWAGE TREATMENT AT LEXINGTON—Illustrated 249
Kansas City Water Supply 252
Some Recent Highway Costs 252
Lowering Water Main with Trench Machine..... 253
An Automatic Release Sling 253
Water Meter Maintenance 253
LINDEN STREET SEWER TUNNEL—Illustrated 254
Municipal Partnership in Water Supply 256
Civic Tour of Europe 256
Atlanta Votes $8,850,000 Improvement Bonds 256
EDITORIAL NOTES 257
Advantages of Pre-cast Tunnel Lining—A Costly Protest Against Inefficient Highway Supervision.
EDUCATING WATER WORKS CONSUMERS... 258
USE OF COPPER SULPHATE IN KANSAS CITY RESERVOIR—By George F. Gilkison 260
DELAWARE HIGHWAY DESIGNS AND SPECIFICATIONS—Illustrated 261
Toledo's Garbage Disposal 263
Reinforced Concrete for Massachusetts Roads 263
San Francisco Votes Against Purchasing Water Works 264
Filtration Plant Recommended for Buffalo 264
Passaic Valley Sewer Injunction 264
Finances of Cities 265
Surfacing on Lincoln Highway 265
Bayonne Desires New Water Supply 265
PAVEMENTS LAID DURING 1920 266
North Carolina's Highway Commission 268
RECENT LEGAL DECISIONS 269

Advantage of Precast Tunnel Lining

An interesting demonstration of the manufacture and use of precast segmental concrete blocks for tunnel lining is afforded by the work now in progress on the construction of the 7-foot 3-inch Linden avenue sewer tunnel near New York City described in this issue. Blocks 12 inches thick having interlocking grouted joints are installed so rapidly and accurately that the tunnel is advanced about 20 feet per day and deviates less than ½-inch from grade or alignment.

The blocks are cast at the site of any required strength, do not need the costly machining necessary for iron segments, require no additional lining and provide a completely finished tunnel as soon as they are set, pointed and grouted, all of which may be completed in a single day. They eliminate the use of temporary lining, develop full strength as soon as assembled, and obviate all necessity for temporary supports, forms or interior concreting apparatus and operations that so much obstruct tunnel space.

Nearly all tunnels require substantial linings to support the roof, to resist external pressures from fluid, semi-fluid or plastic materials, to exclude water, or to provide for a smooth and uniform interior finish, or for all of these reasons.

On account of their strength and convenience and particularly because of their adaptability to use with shield excavators, segmental cast-iron linings have been extensively used, particularly in sub-aqueous tunnels. They are however very costly, may be seriously delayed in manufacture and transportation, and require an interior lining that is applied slowly and with difficulty.

Within recent years segmental concrete blocks have been designed to replace cast-iron lining blocks and have proved successful and satisfactory on several important jobs, notably the Mt. Royal tunnel in dry rock and earth excavation in Montreal, a sub-aqueous Ford tunnel near Detroit, and the Linden Street tunnel.

The tunneling operations are essentially the same as for the cast iron lining. The slow and expensive finishing of construction joints and the large number of joint bolts required for cast iron linings are eliminated.

The principal advantages of the concrete blocks themselves are that they are made when required, at the site, largely with local material; do not require skilled labor for their manufacture, and develop their ultimate strength as soon as assembled in position requiring no additional lining. They are handled by an ordinary or modified type of tunnel erector and form a watertight structure of excellent appearance and great strength. Under favorable conditions they need no reinforcement or costly joint connections, but when necessary can be reinforced to secure any required amount of longitudinal or tensile strength. By filling the void behind the lining, left after the shield moves forward, with gravel under high pressure prevents displacement of the soil, distributes the exterior pressure, and permanently centers the lining. Their use has effected an economy of from 30 to 60 per cent over the estimates of cost of the same work constructed with cast iron lining.

Notwithstanding the very limited dimensions of the Linden Avenue tunnel, machinery has been designed and constructed that enables all of the operations to be carried on in exactly the same manner as for a tunnel several times as large, and thus afford a convincing demonstration of their efficiency.

Engineers and contractors who wish to visit this Linden avenue sewer work will be cordially welcomed by the contractor.

A Costly Protest Against Inefficient Highway Supervision

The State of Illinois, now thoroughly embarked on a highway construction and maintenance program for which there is available in 1921 alone the sum of $20,000,000, faces the strong probability, amounting almost to certainty, of loss of an important per-

centage of that sum through the narrow-gauge, niggardly and inexcusable policy that has resulted in the resignation of its state highway engineer, A. R. Hirst, who during the fourteen years of his connection with this work has had responsible charge of the execution of $40,000,000 worth of road and bridge work.

Mr. Hirst has become thoroughly identified with and strongly attached to the great engineering features of his department and regretfully abandoned work which should be a monument to his state and to his personal reputation and satisfying the creative instinct that is the most important feature of a true engineer's qualifications. He felt compelled to resign, however, because the conditions are such that he finds it impossible to secure the proper execution of the work in accordance with the best interests of the public and first class engineering operations.

His own salary of $7,500 (very moderate for the ability and services rendered), although larger than that of most of the officials in that state, has not of itself been tempting, yet his love of the work and his ambitions for the public good made him wish to continue in his position for the rest of his active life.

In a manly and illuminating letter of resignation he says that he "can no longer be responsible for the proper expenditure of the tremendous sums now available when public sentiment will not support the legislature, the highway commissioner and the county board in the payment of salaries adequate to maintain a favorable and efficient organization that can save or waste hundreds of dollars every step and millions in their construction and administrative policies."

The salary paid the county commissioners is insufficient, the clerical organizations are inadequate, and as fast as the engineering department trains men they are hired away by commercial organizations. In 1920 the State Highway Commission lost 27 per cent of its principal employees.

In spite of the handicap of underpaid staff and a huge turnover in its personnel, the highway department has probably gotten 75 per cent of the results that might have been attained with adequate public support, but a new era of enormous expenditures is now being entered and the competitions for brains and experience of superior value in planning and building highways and for talent in all the fields allied to highway construction is keen and intense, and unless the public "equips itself with eminently fitted representatives the losses in poor roads and unjustified prices will be appalling."

As Mr. Hirst's utmost efforts have, through lack of public support, failed to remedy the evil, he feels that his only alternative in justice to himself and the public is the resignation which is sure to be a deplorable and extremely costly protest for the State. This, or greater, is the price that the public must pay when it cannot or will not recognize or remunerate honesty, ability and efficiency.

The city of Winona, Miss., has issued $60,000 worth of bonds for the purchase of the plant of the Winona Light, Ice, Water and Sewerage Company. The plant will be entirely remodeled and will be put on a paying basis, known as the Winona Public Utility Plant. Water and light service will be extended to cover the whole town, instead of covering not over 50 per cent, as at present. Both water and electric service will be put on 100 per cent metered basis.

Jno. T. Sharp, Jr., who is at present superintendent of the Canton Electric Light and Water Works, has been made manager of the Winona Public Utility Plant and will have charge of both plants and will do the purchasing and engineering. H. E. Johnson, recently of Dyersburg, Tenn., is local superintendent at Winona.

Educating Water Works Consumers

Obtaining confidence and co-operation of consumers in changing from flat rate to meters, by first educating employees.

The business policies and methods of the Spring Valley Water Co. of San Francisco were described at some length by the water sales manager of the company, O. E. Clemens, in a paper before the California section of the American Water Works Association at a recent meeting.

One of the most interesting features was the method employed by the company in securing public confidence and co-operation in changing from flat rate to meter rate.

The company began installing meters on residential services during the summer of 1916 for test purposes, as meter rates could not be applied to that class of consumers under the ordinance then existing. The idea met with a wave of opposition, but in October 1918 the state railroad commission authorized the use of meters and the application of a modern system of rates based on metering. Anticipating the consent of the railroad commission, the company had continued installing meters and by October 1918 had 50,000 set, in addition to the 20,000 which already existed on the commercial services. There are now about 75,000 meters in the city, of which 3,500 are installed in basement areas under the sidewalks in the downtown section and the remaining 71,500 are in the sidewalks along the curb line. About 20,000 accounts are commercial, consisting of factories, refineries, shops, railways, stores, hotels, and apartment houses, and over 50,000 are residential accounts. Altogether there are about 72,000 active consumers. (Apparently a number of the consumers are supplied through more than one meter.)

In spite of the original opposition, "after two years of intensive educational and service work, the public is now thoroughly converted to meters and we can state with the utmost confidence that if the question should be put to a vote, those in

favor of returning to the former system of billing for water service would be hopelessly in the minority." This result was secured by educating both the public and the company's employees and by serving the public to the best of the company's ability.

In educating employees, classes were held at the shop, where they were shown the workings of the water meter and what a wonderfully accurate instrument it is, how seldom it can get out of order and how, if it does go wrong, it is almost always in favor of the consumer. "The time spent on this was well worth while, for the men gained full confidence in the instrument and could meet any and all comers on the subject. And many men were found in this city, otherwise very intelligent and well read, who possessed a blind and unreasoning prejudice against meters and honestly believed that they could not be depended upon for accurate registration.

"The next step was to drill the company's personnel in the logic of the new rate schedule. This schedule is one that at first aroused much adverse comment owing to the elimination of the familiar minimum bill and the substitution of the monthly service charge, an item independent of the charge for water delivered." Mr. Clemens described at some length this system of rates, which has been adopted by a number of cities in the east and described several times in this journal. The monthly service charge was designed to cover the cost of "maintenance and repairs to mains and services, inspection of plumbing and fixtures for the consumers, reading meters, bookkeeping, billing and collecting." As adopted by this company, it also includes the estimated cost of water passing through the meter without being registered. Mr. Clemens stating that tests had shown that the average ⅝-inch household meter passed an average of about 50 gallons a day without registering, and larger meters proportionately larger amounts. The service charge was fixed at 65 cents a month for ⅝-inch meters, increasing for the various sizes up to $40 a month for a large 8-inch connection.

In commenting upon the service charge system, the Railroad Commission said: "The minimum charge is invariably higher than the service charge, and it involves the payment by each consumer for a fixed amount of water regardless of whether or not he uses it. There is no answer known to us which can be made to the man who complains that under a minimum rate he is compelled to pay the same amount for 100 cubic feet of water as his neighbor pays for 300 to 400 cubic feet, depending upon the amount fixed for minimum use.

"We believe that under the conditions of service we are dealing with herein, the service charge once established and thoroughly understood will be agreed to as the fairest and most equitable method of fixing rates."

In educating the public, the company wanted quick results and used paid advertisements in the big dailies and also in the district newspapers. An expert in advertising was placed in charge of this, and explained in simple and effective language the whys of metering and the new meter schedule. Adverse arguments made by consumers were quoted and answered. The causes of large water bills were enumerated and specific cases of cause and cure were cited. The square deal was constantly preached and was lived up to by the company's operating forces. The public was invited to come to the company with its water troubles and to call on its service department for assistance.

The advertising was backed up by real service and all complaints, no matter how trivial, were thoroughly investigated and helpful letters sent to the complainant. Defective fixtures were located and specific recommendations regarding repairs were made. Unnecessary and wasteful uses were pointed out and constructive criticism offered. As a result, instead of an office full of irate consumers and a host of insulting letters in every mail, the company receives only relatively few complaints at the information and adjustment window; asking, not demanding, an investigation of abnormal bills and leaving entirely to the company the question of the adjustment of the cost of water lost through the leaking fixtures. Hardly a mail delivered but brings one or more letters of appreciation from pleased consumers.

"The results accomplished and the good feeling developed have repaid a hundred fold the money and energy expended on this educational and constructive campaign. Aside from the tremendous saving of four billion gallons of water a year, previously wasted and benefiting none, it is possible to point to concrete saving in operating expense, largely attributable to the changed attitude of the public and its wholesome effect on the morale of the company's employees."

Comparing October 1920 with October 1915, the number of active consumers increased from 66,000 to 72,000 but the average delivery of water decreased from 45 million to 36½ million, while the gross revenue increased from $298,000 to $331,000. The number of employees decreased from 119 to 113, the number of plumbing and rating inspectors having decreased from 19 to 8, the field collectors from 24 to 21, builders and contractors supply from 7 to 1, shut-off men from 7 to 4; while the meter readers increased from 9 on ⅔ time to 13 on full time, and the bookkeepers and billers from 14 to 28. The smaller force handles a larger business and gives the public more satisfactory personal contact. The reduction in the force is due partly to the reorganization and realignment of the department, parly to the 100 per cent metered condition of the business, partly to improvement of some methods, the elimination of others and the introduction of new ones. In addition, credit must be given to the changed attitude of the public, which has been meeting the company in a co-operative way which greatly improved the morale of the employees and indirectly increased their efficiency.

Although 36,500,000 gallons per day are delivered to the city reservoirs, only 29,800,000 are measured by the meters, 18,000,000 of this going

to commercial consumers, 10,000,000 to residential, 1,000,000 for municipal uses, 750,000 to ships and 50,000 to contractors and construction work. The unmeasured 6,700,000 gallons covers fire uses, reservoir evaporation, leaking in mains and services, flushing of mains and sewers, and presumably meter slippage.

All meters are read once a month, the entire city being covered by 13 readers in 21 working days. The average number of meters in basements read per day, is 100 to 150, while of the other meters 250 to 300 per day are read in the semi-commercial district where readers are delayed by traffic, merchandise on the sidewalks, etc.; and in the open section solidly built they average better than 500, some runs reaching 700 in 7 hours reading time. The five remaining days of the month are occupied in taking readings previously unobtainable, cleaning dials, and working up reports on broken boxes.

Use of Copper Sulphate in Kansas City Reservoir *

By GEORGE F. GILKISON †

Application of copper solution directly onto walls successful after other methods had failed.

The object of this paper is not to introduce a new method for the control of algae, but rather to show how the Kansas City, Mo., Water Department has, by changing the application of copper sulphate from the water to the basin walls, been able to control this annoying growth in their clear water basins.

Kansas City takes its water supply from the Missouri river at the Quindaro pumping station, 10 miles above the city. This station has a basin capacity of 90,000,000 gallons. The water is purified by sedimentation aided by coagulation and chlorination. It is then delivered to the Turkey Creek station, which is the distributing station. There are seven storage basins with a total capacity of 38,000,000 gallons located at different points throughout the city. It is in these basins that the algae growth causes the most annoyance. The basin becomes very unsightly, due to the fact that Spirogyra predominates and appears in long filaments throughout the basin. It also causes trouble in the meters by stopping up the strainers. At times offensive odors are generated, due to the development of Anabaena and other blue-green algae.

The method first used to control this growth was to scrub the walls with long-handled wire brushes. This was not successful. The algae was torn loose from the walls and a large amount of it floated in the water and would attach itself to the wall again at the first opportunity.

The next method tried was taking a known amount of copper sulphate in a sack and by means of a rope attached to it, dragging the sack along the wall on which the algae was growing. The disadvantages of this method were that the current caused by the sack would carry the copper sulphate solution away from the wall and the strength of the solution being applied was unknown. This method also required a great deal of time, as the sack had to be drawn back and forth over the same wall to kill the algae growth.

To overcome the uncertainty of concentration, an experiment was made at the Quindaro station in which the copper sulphate was applied with the coagulant to the water. Copper sulphate being incompatible with aluminum sulphate, the two were dissolved in the same solution and applied to the water as it passed over the weir by means of a perforated pipe line. The volume of water passing over the weir was known. Copper sulphate was added at this point, and in this way it was possible to calculate the parts per million in the basin. A start was made with 0.25 part per million and this was progressively increased to 1.5 parts per million. There was no apparent action on the wall growth until the concentration of the copper sulphate reached 1 part per million, and at that concentration the algae at the end of the basin at which the copper sulphate was being applied was killed, but 1.5 parts per million were necessary to clear the far wall. This experiment was followed by an enormous increase in the bacterial count in the basin. The alkalinity of the water at the time of this experiment was 185 parts per million. While chemical analyses were not made on the effluent water from this basin, it is safe to say that most of the copper sulphate was lost by reaction with the alkalinity of the water. The following varieties of fish were present in the basin: catfish, carp, perch, drum, shad and buffalo, none of which was killed.

Copper sulphate is now used in a known strength solution, and is applied directly to the algae growth on the basin walls. The water elevation in the basin to be treated is brought down below the algae line, which is about 6 feet below the normal elevation in the basins. This leaves the algae clinging to the wall. A paint spraying pump is attached to an 8-gallon keg which is mounted on wheels and equipped with a handle. A 5 per cent aquacous solution of copper sulphate is made by dissolving 6½ pounds of copper sulphate crystals in 10 gallons of water and poured into the keg. While one man operates the pump another man directs the flow of the solution, which is delivered in a fine spray. After an hour the walls are scrubbed with a wire brush and the basin is again filled to normal elevation.

One gallon of this solution will cover 125 square feet of wall surface and can be applied by two men with a spraying machine in four minutes. By carrying out this method every two months during the warm weather, it is possible to keep the basin walls comparatively free from algae.

*Paper before the Iowa Section of the American Water Work Association, November 6, 1920.

†Chief Chemist, Water Department, Kansas City, Mo.

Delaware Highway Designs and Specifications

Some of the more important features of the specifications with reference to freight rate compensation, excavation, mixing, finishing and protecting concrete, bridge construction, etc.

As stated in a previous article dealing with the Delaware State Highway Department, concrete pavements were adopted as the general standard for that state, with brick pavement on a concrete base and penetration macadam for special cases. These conform to seven typical cross sections, with different dimensions as shown in the accompanying diagram. Their construction is governed by specifications that conform to advanced practice, with some special features designed to provide for local conditions.

Some of the features of the specifications that have received special study or are thought to be particularly important are here presented. They are well calculated to promote the excellence of the work and to secure hearty co-operation of the contractor by assuring him of fair treatment and consideration.

FREIGHT COMPENSATION

In case freight rates are increased after the receipt of bids and before the date set in the proposal for the completion of the contract, the contractor will be paid extra an amount equal to the increase in freight rates paid by him on the materials used in this contract, the receipted freight bills having previously been filed with the department.

Likewise deductions will be made in a similar manner should a reduction in freight rates be secured.

EXCAVATION

Excavation includes the grading and rolling and otherwise compacting of the surface of the roadway and shoulders and the cleaning and sloping to grades of side ditches. A sub-grade must be shaped and compacted to conform to line and grade and brought to an even surface by rolling the entire area with a three-wheel power roller weighing at least 10 tons and by tamping any portion inaccessible to the roller. The sub-grades must be maintained undisturbed at least 200 feet in advance of the placing of the roadway materials. If an existing macadam road surface corresponds approximately to the grade of the proposed roadway it shall be scarified to a depth of at least 4 inches for the full width of the new pavement and shaped to conform to the new cross section.

An important requirement intended to prevent the formation of longitudinal cracks provides that, if the roadway of the present road follows the traveled way of an old road, then the surface of the old road, which is beneath the new pavement, shall be thoroughly plowed and scarified to a depth of 10 inches below the original surface, after which it shall be reshaped and rolled as hereinbefore specified to secure a sub-grade of uniform rigidity.

CONCRETE PAVEMENT

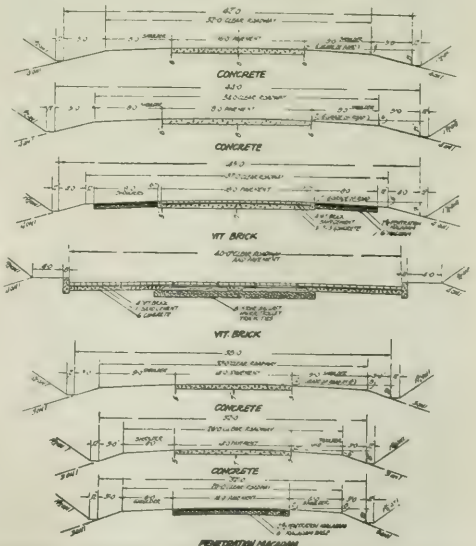
Immediately before laying the concrete, the sub-grade shall be checked with an approved template and shall be brought to true grade. If this requires the addition of loose earth it must be thoroughly tamped by hand. Rakes must not be used for spreading concrete. The forms must be maintained in position true to line and grade at all times for at least 200 feet in advance of the concrete mixer and retained in position for at least 12 hours after the concrete has been placed.

Mixing Concrete.—Boxes with bottoms or approved wheelbarrows shall be furnished and used for measuring the aggregate, built to such dimensions as, when struck, will give the required volume. Every box or barrow shall be struck off before emptying.

The mixer shall be equipped with an automatic locking device, which will prevent the mixer being discharged until the batch has been mixed the required time.

The mixer shall also be equipped with an automatic water measuring device and a visible water gauge.

Concrete shall be mixed in the proportions of:



TYPICAL SECTION OF DELAWARE STATE AND STATE AID ROADS

1 standard bag portland cement, 0.1 cubic ft. hydrated lime, 2 cubic ft. of fine aggregate, and 4 cubic ft. of coarse aggregate. Except that, to secure the densest mixture, the engineer may vary the coarse aggregate up to 5.

The materials shall be mixed in a batch mixer of approved type for 1½ minutes after all the materials are in the drum, at a speed of not less than 14 nor more than 20 revolutions per minute. Any batch mixed less than 1½ minutes shall not be allowed in the roadway, and shall be disposed of as directed. No material shall be placed in the drum until all the previous batch has been discharged. Water shall be added at the time the materials are being run into the mixer. Only sufficient water shall be used to produce a plastic, workable concrete, of which each and every batch must be of uniform consistency, as determined by the engineer. Concrete that will flow on the sub-grade, or in which there shows any tendency towards segregation of the aggregate, will not be permitted.

Finishing Concrete.—On all contracts of 3 miles or over in length, the surface of the concrete shall be struck off, tamped and belted with an approved finishing machine in such a manner as shall be acceptable to the engineer. On contracts less than 3 miles in length, the surface of the pavement may be finished by hand in the following manner: The surface of the concrete shall be leveled and immediately struck off by means of a steel screed or template weighing not less than 25 pounds per lineal foot and having a face resting on the forms of not less than 8 inches in width. The template shall be moved with a combined longitudinal and crosswise motion. If necessary, the template shall be used a second time or until a true surface is obtained. While the concrete is being struck off, at least 3 men shall be at work, leveling, spading and tamping the concrete in front of the template.

After the concrete has been struck off, it shall be rolled with a roller approximately 6 feet in length, 12 inches in diameter, and weighing from 12 to 15 pounds per lineal foot. The roller shall be moved slowly at a uniform speed from one side of the pavement to the other, diagonally so as to advance it longitudinally not more than 2 feet in passing from one side of the pavement to the other. The rolling shall be continued at intervals until free water ceases to come to the surface, and this operation shall be repeated at least three times.

After the rolling has been completed the concrete shall be finished by a bow belt not less than 10 inches in width. The belt shall be of 4-ply canvas-rubber composition, about 1 foot longer than the width of the pavement and stretched tight by means of a wooden bow. The belt shall be moved with a see-saw motion across the pavement using long, vigorous strokes, with a slight longitudinal advance, which may be increased in later beltings. Just before the initial set takes places the concrete shall be given a final belting in order to produce a uniform surface of gritty texture. This belting shall be of short, rapid, transverse strokes having a sweeping longitudinal motion. Badly worn belts shall be rejected and new ones supplied. The outer edge of the concrete pavement shall be finished with an edging tool ¼ inch radius. Joints shall be installed at the end of each day's work or whenever the mixer is stopped for more than 30 minutes or when directed. At each joint shall be placed five ⅝ inch round, smooth steel bars 4 feet long, dipped in tar or asphalt to insure freedom of movement within the concrete.

Protecting Fresh Concrete—Freshly laid concrete shall be protected from the sun and wind by canvas covering placed so as not to come in contact with the concrete surface. In case of rain, the covers shall be removed until the rain is over. After the concrete has hardened sufficiently, the surface of the pavement shall be covered with not less than 2 inches of earth, which shall be kept soaked with water for at least 14 days. The earth covering shall not be removed for at least 30 days, and in cool weather for an additional time if required by the engineer. The method known as ponding may be used if desired, the surface of the concrete being kept covered by water for 14 days. For each 1000 feet of concrete pavement which has been laid less than 14 days, there shall be at least one man who shall devote his entire time to watering.

A 10-foot straightedge shall be placed parallel to the center line of the highway, so as to bridge any depressions, and ordinates measured from the face of the straightedge to the surface of the concrete shall not exceed 1-16 inch for each foot in distance from either point of contact. When variations are found in excess of this amount the contractor shall either remove the entire slab or correct the unevenness in a manner acceptable to the engineer, but no depressions shall be filled with concrete unless the slab has been cut so as to secure a thickness of 4 inches of new material with vertical sides.

BRIDGES

Few streams are crossed by the state highways and the maximum span does not exceed 50 feet, therefore bridge construction does not involve great engineering difficulties or elaborate equipment. Separate designs adapted to the conditions and requirements are made for each span. All of them are made heavy for all possible future traffic, with dimensions to give ample clearance for waterways and vehicles, are neatly finished and present an attractive appearance suited to the surroundings.

Concrete in the arch ring, spandrel walls and foundations is designated on the plans to be one of three grades, respectively proportioned 1 cement, 2 fine aggregate and 4 coarse aggregate; or 1 cement, 2½ fine aggregate and 5 coarse aggregate; or 1 cement, 3 fine aggregate and 6 coarse aggregate.

No concrete shall be deposited in water. If it is found impossible to keep the foundation dry on account of springs in the bottom, a layer of concrete not more than 6 inches deep shall be spread over the bottom to seal it, and after it has set, the water shall be pumped out and the remainder of the foundation placed in the dry.

The surface finish of all exposed concrete shall be spaded, rubbed or tooled. The arch ring shall not be concreted until the fill around the abutments has been carried up to the skewback. Arch rings shall preferably be cast in a single continuous operation; but where this is impracticable they may be divided, by vertical bulkheads, into longitudinal sections, or by radial bulkheads into trans-

verse sections, of such size that each section can be cast in a continuous operation.

Transverse sections shall be so arranged that initial stress will not be created in the reinforcement. In either method, work shall be carried on symmetrically about the crown of the arch and the sections shall be keyed or doweled together as the engineer directs. The spandrel walls shall not be cast until after the centers have been struck if so directed by the engineer or called for on the plans, and no part of the coping or railing shall be cast until the spandrel wall has been completed. In favorable weather, centers shall remain in place under arches of less than 60 foot span for at least 21 days. In unfavorable weather centers shall remain in place under all arches as long as the engineer may deem necessary.

UNDERGROUND WORK

In order to deal justly with the contractor when unforeseen conditions are developed in the construction of foundations, it is provided that if it becomes necessary to carry the foundations for any structure below the depths shown on plans, additional payment will be made by increasing the unit price of the additional concrete so required on the following basis:

For the first foot below the grade shown on plans, the unit contract price for concrete masonry of the class called for, plus 10 per cent;

For the second foot, the unit contract price plus 15 per cent; and increasing for each additional foot 5 per cent of the unit contract price.

Toledo Garbage Disposal

Toledo, Ohio, has recently let a contract for disposing of its garbage by the reduction method, the contract having been awarded to the Toledo Disposal Company. Under this contract the city pays $1.25 a ton.

Bids were first received by Service Director Goodwillie in April, 1920, when, as described in our issue of May 8, four of the bidders offered to pay the city for the garbage and the fifth, the Toledo Disposal Co., asked to be paid $.89 a ton under a ten-year contract. Of the first four, two proposed to feed the garbage to hogs, one offering the city $1.25 a ton under a ten-year contract and the other $1.26 a ton under a five-year contract. A third, the Michigan & Ohio Nu-Fuel Co., offered to pay $.75 a ton upon the basis of fuel manufactured from the garbage under a twenty-year contract. The fourth, the Pan-American Feed Milling Co., which proposed to convert the garbage into food for livestock, offered to pay $1 a ton.

The reduction method had already been used in Toledo for many years by the Toledo Disposal Co., which was paid $5,875 per year, the garbage being delivered by the city at the plant. The hog-feeding method had not been tried in Toledo and involved the finding of a suitable location for a hog farm in a neighborhood where it would not be a nuisance, and this involved considerable length of haul with the increased cost involved. The other two were new ideas which had not yet been tried out extensively.

For these and other reasons the service director decided not to award the contract on bids which were apparently most favorable, but to redraft the specifications and readvertise. In the new specifications, among other things, the definition of garbage was made clear and explicit and it was provided that no method would be considered that had not been in successful operation for at least two years. Also rigid requirements were set forth designed to insure sanitary handling of the garbage. The plant was required to include the office building and scale house with a wagon scale having a capacity of 20 tons, space and equipment for washing and cleaning the garbage wagons, with a sufficient water supply, a telephone at the plant, etc.

The specifications stated that "Consideration will be given by the city in the awarding of this contract not alone to the reliability of each bidder and his proposed process, together with the price offered as compensation to or from the city of Toledo for the garbage disposal, but also to the proposed location of the plant and the expense to the city to transport and haul the garbage to the plant or plants proposed to be constructed by said contractor."

Only three bids on the above specifications were received, two for hog feeding and one for reduction, the last of which was accepted. One of the former offered to pay the city $1.26 per ton, while the second offered two proposals, under one of which the city would pay $1 per ton, while the other offered to pay the city 5 cents per ton for delivery of the garbage at the city limits and 10 cents a ton additional for each mile of haul beyond the city to the hog farm.

The two hog-feeding proposals would have required a haul of seven or eight miles in one case and thirty miles in the other, the cost of which would soon have eaten up the difference in cost of disposal. Collection and delivery cost the city $76,000 in 1919, while disposal cost but $5,875. The service director estimated the cost of collection at $2.86 a ton as against $.29 a ton for disposal.

The amount to be paid the company under the new contract is considerably more than that paid under the present one for the past ten years, but the company claims that the increase is made necessary by the great increase in cost of coal and labor and the fact that the new contract requires more sanitary handling of the garbage.

Reinforced Concrete for Massachusetts Roads

The Highways Division of the Massachusetts Department of Public Works is expecting to build this year concrete roads with reinforcement, which has not heretofore been used in Massachusetts, although it has been in Pennsylvania, Illinois and other states. Probably the first of these reinforced concrete roads to be built will be on the Worcester-Springfield route, where the state expects to build something more than three miles of road 20 feet wide with a 3-foot shoulder on each side, both road and shoulder to rest upon a broken stone foundation. The road will be 6 inches thick at the sides and 7½

at the center, the under side being level, thus furnishing a crown of 1½ inches. At curves the concrete will be widened to 23 feet and banked for the greatest speed permissible, but so far as possible the curves will be made flat so that little banking will be required. The reinforcement will consist of ½-inch rods, which will extend through the expansion joints so that they will act as dowels. A longitudinal expansion joint will run continuously through the middle of the road and transverse joints will be placed at intervals of about 100 feet.

Filtration Plant Recommended for Buffalo

A water filtration plant to cost about $4,000,000 has been recommended by Arthur W. Kreinheder, commissioner of public works of Buffalo, in a communication sent the council on March 16. He asks that the council authorize the Bureau of Water to have plans and specifications prepared so that bids for a filtration plant may be obtained not later than February 1, 1922. He would have a sufficient amount of land already owned by the city set aside for this purpose, with area sufficient for a plant with a capacity to serve one million people. He recommends that the architectural plans for the buildings enclosing the plant conform to the architecture of the pumping station, and that the surrounding grounds be co-ordinated with the lands of the park department in that section.

The recommendation is based on a report recently completed by water commissioner George C. Andrews and George W. Fuller, of New York, as consulting engineer. Messrs. Andrews and Fuller, who have been studying the subject for over a year, report that the water supply of Buffalo is objectionably turbid for at least three months of the year when storms stir up the comparatively shallow end of Lake Erie in the vicinity of the intake. The only practicable remedy for this is filtration. A rapid sand filter with a rated capacity of 160,000,000 gallons per day plus a 15 per cent overload is recommended, believed to be ample for the city's needs until 1935. The cost, $4,000,000, is based upon present prices. The operating expenses are estimated at $125,000 a year. Buffalo has recently increased its water rates and it is estimated that the increased revenue combined with a reduction of water waste and control of consumption will be sufficient by 1925 to pay the interest and sinking fund charges on this investment as well as for the maintenance of the plant. One year is allowed for preparation of the plans for the plant and two or three years for its construction.

Although since the chlorination process was installed in 1914, the typhoid fever death rate in Buffalo has decreased approximately 50 per cent, the rate is twice as high as in Boston, New York, Cincinnati, Chicago and many other large cities.

Commissioner Kreinheder believes that "in times of industrial depression municipalities should prosecute public improvements. From present indications I am satisfied that during 1922 and 1923 construction costs will be lower and that it will be possible to build the plant at a reasonable expense."

San Francisco Votes Against Purchasing Water Works

On March 8, San Francisco voters defeated a proposal submitted to them for purchasing the property of the Spring Valley Water Company. Although the vote was 42,898 in favor and 31,082 against, a two-thirds vote was necessary to adopt the measure, which called for issuing bonds. There was very little organized opposition to the measure and on the other hand nearly all the civic, social and labor organizations of the city officials endorsed it. It appears that the opposition was based largely on the assumption that the $38,000,000 demanded by the company for its properties exceeded their value, although the railroad commission had fixed it at that amount.

This is the third time that this question has been before the voters, the first having been in 1910 and the second in 1915. In 1910 the property was offered for $35,000,000 and in 1915 for $34,000,000, but with certain properties not included which had been included in the first offer, thus making it really less reasonable.

Only a few years ago the people voted overwhelmingly in favor of obtaining a municipal water supply by building a large reservoir in the Hetch-Hetchy valley, authorizing $45,000,000 for that purpose. The owners of irrigable lands in that valley succeeded in having imposed on the city a number of conditions, one of these being that it would make use of all near-by sources before interfering with the rights of irrigation claimants. City officials have stated that there is now no possibility of obtaining water for the city from Hetch-Hetchy during the present generation, and the cost of bringing it from that source is so great that, if added to the amount that would have to be paid to secure the near-by Spring Valley supply, would bring San Francisco's bonded indebtedness nearly to the charter debt limit. In fact, the idea of obtaining a water supply from that source has now been practically abandoned and it is considered only as a power proposition.

Passaic Valley Sewer Injunction

In an article under this head which appeared in the issue of March 5, appeared a statement which is contradicted by the writer of the following letter, who was designing engineer for the commission referred to. As stated in the article, the paragraph referred to was abstracted from a report of the injunction suit and presumably the counsel in the case was responsible for the erroneous statement. The object of the statement apparently was to prove that New York City was preparing to take very pronounced and expensive steps toward preventing pollution of the harbor.

Editor, PUBLIC WORKS:
New York City.

SIR: May I correct an error in the statement on Page 208 of PUBLIC WORKS for March 5 that "an artificial island was proposed (by the Metropolitan Sewerage Commission) for another plant at a cost of more than $41,000,000."

This referred to the project for collecting 200 million gallons of sewage daily from the territory draining to the Lower East River below Newtown Creek on the East Side and 26th street on the west to a pumping station at South 5th street, Brooklyn, and pumping through a 12-foot 8-inch tunnel to an artificial island some 3 miles south of Coney Island, where it would be settled and discharged by submerged outlets.* Reference to Page 124 of the Commission's final report (1914) shows that this was estimated at $17,395,000 instead of $41,000,000, as in the article referred to.

As there has been much misapprehension as to the entire proposition, both scope and cost, it may be of interest to state that the volume of 200 million gallons daily by no means represents all of the sewage tributary to the Lower East River, the balance of which would have been treated locally in either this or the Red Hook Project and to give further details as to the cost as estimated early in 1914.

Estimated cost of ocean island project made in 1914 and based on a mean flow in 1960 of 200 million gallons daily:

Construction	
Interceptors, including storm overflows, grit chambers and screens	$ 2,186,800
East river siphon	282,100
Pumping stations	1,971,000
Force main and outfall sewer	8,627,000
Outland island	615,500
Treatment plant	1,125,000
Outlet well and submerged outlets	178,000
Sludge steamer	140,000
Engineering and contingencies	2,268,600
Total	$17,394,000

Annual Charges	
Maintenance of interceptors and outfall sewer	$ 11,300
Pumping	258,000
Grit removal, sewage treatment and sludge disposal	162,100
Fixed charges	880,100
Total	$1,311,500

With the exception of one or two of the smaller items I have never seen any occasion to revise these figures for the date when they were made although they would naturally be very much greater to-day. The moderate cost of constructing an island in the Lower Bay is explained by the shallow water at this location and the favorable conditions for construction.

Very truly yours,
Kenneth Allen.
Sanitary Engineer, Board of Estimate and Apportionment, City of New York.

*Described in *Municipal Journal* for November 4, 1915

Finances of Cities

The report of the Census Bureau on the financial statistics of cities of 30,000 population and over for 1919 will soon be issued and a synopsis of the figures has been given out by the bureau. The statistics have been compiled under the direction of Starke M. Grogan, chief statistician for state and city statistics and includes 227 cities.

These cities made total expenditures exceeding their revenues by nearly $9,000,000, or about 26 cents per capita; but the revenues exceeded payment for current expenses and interest by more than 25 times that amount. That is, if we omit expenditures made for permanent improvements, the cities lived well within their incomes and almost paid for all of their permanent improvements as well. There were only four cities in which the revenue receipts did not exceed the current departmental expenses and interest, and in 52 per cent of the whole number, including some of the larger cities, the revenues exceed all expenditures for governmental costs, including permanent improvements. In 1918 this last statement could be made of only 35 per cent of the cities.

Averaging all of the 227 cities, the expenditures for governmental costs was $35.58 per capita. Of this total, $21.75 was for expenses of general departments—legislative, executive and judicial establishments, schools, police and fire departments, sanitation, etc.; $7.38 per capita was for outlays (permanent investments); $4.52 was for interest on indebtedness, and $1.92 was for expenses of public service enterprises such as water supply systems, docks, wharves, etc.

Next to taxes, the largest revenue was derived from public service enterprises, the earnings of these having totaled $127,399,258. This sum exceeds the payments for such enterprises by $60,699,192, or $1.76 per capita. Nearly 80 per cent of this revenue, or $95,000,000, came from water supply systems.

The net indebtedness, being the funded and floating debt less the assets in general sinking funds, totaled $2,697,551,844, or $77.82 per capita.

Surfacing on Lincoln Highway

The Lincoln Highway as now laid out contains 3,305 miles from Broadway and 42d street, New York, to the Golden Gate, San Francisco, which is about 84 miles less than the route as it was laid out seven years ago. The Lincoln Highway Association reports that 2,853 miles of this distance has been improved, 542 miles of this having been done in 1920. This improvement, however, includes a considerable amount of grading only; in fact, about 1,880 miles, or nearly 60 per cent, consists of graded gravel, natural gravel, graded earth, natural earth, and sand.

Of the surfaced road, 422 miles is of concrete, 402 miles of bituminous macadam, 287 miles of macadam, 220 miles of brick, 78 of earth, 6 of creosoted block and 7 of granite block.

It is reported that a total of $31,284,520 has been spent upon the Lincoln Highway thus far, and it is hoped to add $10,000,000 worth of construction work to the highway during 1921. During 1920, 127 miles of concrete road was built, 12 miles of bituminous macadam, 7 miles of brick, half a mile of macadam, 188 miles of gravel and 207 miles of permanent earth grade.

Bayonne Desires New Water Supply

Among the several New Jersey cities that are endeavoring to secure the few remaining sources of water supply in northern New Jersey is Bayonne, which is seeking to obtain the right to construct a dam across the Ramapo river at Oakland and create a reservoir with a capacity of 15,000,000,000 gallons, with the right to divert 50,000,000 gallons a day for its own use and that of adjacent municipalities with which it may make contracts. This plan is being opposed by wealthy residents of the valley, who claim that $10,000,000 worth of property would be destroyed by the creation of the reservoir. The matter is still before the State Board of Conservation and a decision is expected within the next few months.

Pavements Laid During 1920

Quantities are square yards or miles otherwise indicated.

City and State	Sheer Asphalt	Asphalt Concrete	Tar Concrete	Warrenite-Bitulithic	Bitoslag	Rock Asphalt	Willite	Asphalt Macadam	Tar Macadam
South Carolina:									
Charleston	7,633				5,900				
Chester	10,000								
Manning		65,000							
Spartanburg					24,653				
South Dakota:									
Madison					33,363				
Tennessee:									
Nashville									20,000
Texas:					115,053				
Bonham					87,147				
El Paso					61,353				
Ft. Worth					51,543				
Houston									
San Antonio					33,935				
Utah:					26,546				
American Fork					27,138				
Brigham City									
Lehi								1.6	
Virginia:	1.86				6,077				
Roanoke									
Richmond					2,500				
Washington:					30,000				
Camas					25,890				
Dayton					4 563				
Grandview					19,073				
N. Vancouver					53,260				
Puyallup					41,379				
Tappenish					1,327				
Vancouver									
Yakima						30,050			
Wisconsin:									
Ashland	63,425				12,377				
Janesville		7,373							
Port Angeles					29,399				
Canada:					19 468				
Brampton, Ont.					31,553				
Brockville, Ont.					24,619				
Chilliwack, B. C.					3,176				
Moncton, N. B.					5,525				
Owen Sound, Ont.					9,009				
Pickering, Ont.					7.95				
Sarnia, Ont.					39,470				
St. Boniface, Man.	11.81				13,219				
Toronto, Ont.		.44			1,607				
Vancouver, B. C.									
Walkerville, Ont.									
Woodstock, Ont.									

Cities and States	Amiesite	Granite or other Stone Block	Brick or Clay Block	Creosoted Wood Block	Concrete Reinforced	Concrete not Reinforced	Plain (water-bound) Macadam	Gravel	Cement Sidewalks
Alabama:								3,000	
Gadsden									
Arizona:						500			100,000§
Douglas								19,000	1.50
Arkansas:									
Pine Bluff									2,400b
California:									
El Centro						101,775		885,721	1,008,452§
Los Angeles								3	½
Monrovia						¼			
Ontario						153,431			11,525§
Pasadena					18,000			32,000	5,000
San Luis Obispo									
Colorado:								3	
Boulder					5,000			4,118†	1,000§
Ft. Collins									100§§
Salida									
Connecticut:									2,000
Ansonia		1,000			3,000		1,200		
Norwich									10,000§
Stamford									
Georgia:					½	3.7		3	2
Augusta									
Idaho:							3		
Coeur d'Alene									
Illinois:							4,700		
Cairo		.04	2.37	22		16.12			
Chicago						3,600			11,760§
Chicago Heights			6,090b	3,188b					3
Decatur						7,223			2,295b
Evanston					1,040	1,566			58,000
Moline						45,962			
Oak Park									1,000§§
Olney			32,000	28,300	2,620	1,717			
Quincy									4,400
Savanna			22,000		2,210				
Wheaton								823	3,697§
Indiana:						3,135.84			
Crawfordsville						1,707			14,642§
Evansville						10,127	2,014		17,716
Kokomo							7,000		½
New Albany									
Wabash									

PAVEMENTS LAID DURING 1920 Continued

City and State	Sheet Asphalt	Asphalt Concrete	Tar Concrete	Warrenite-Bitulithic	Bituslag	Rock Asphalt	Willite	Asphalt Macadam	Tar Macadam
Kansas:									
Arkansas City			79,000						
Columbus									
Kansas City			4,800			3,500			
Louisiana:									
Lafayette								2½	
Monroe									
Maine:									
Portland		2,928							
Maryland:									
Frederick			500			3,200			
Massachusetts:									
Framingham						4,476		12,300	21
Holyoke		684				39,402			
Lawrence		6,900							
Lowell		5,829					14,737	24,237	
Malden		2,100				3,200			1,800
Medford		8,716							
Newton								52,606	52,000
Provincetown									
Webster									1,850
Michigan:									
Bay City									8,000
Holland									20,000
Ishpeming								3,500	
Munising							500		1,000
River Rouge					17,185.48				
Saginaw								4,500	
Minnesota:									
Chisholm									2,000
St. Cloud									11,500
Missouri:									
Boonville						3758 s			
Jefferson City								10,000	8,000
Maplewood					14,000				2,000
Nevada								6½	
Poplar Bluff									4,000 s
St. Louis		7,104	34,845	39,193		6,460			
University City						3,440			
Montana:									
Havre								1½	
New Jersey:									
Bridgeton					19,263			5	
Irvington					2,400	16,109			
Millville									
Paterson					1,700			½	
Roosevelt					10,000		71,021		
Roselle Park					14,360				20,000
New York:									
Albany		5,000	10,500		11,000	1,100			
Elmira			14,871						
Glens Falls					165				21,600 s
Hornell							1	2	
Jamestown			13,000						
Lockport			24,800c		110,100				
Plattsburgh									3,000
Port Chester		1,166							30,000 s
Poughkeepsie						5,370			
Richmond		20,846	9,144	7,810		3,701	2,812		181,637
Schenectady					5,312.08				
Syracuse			1.63	0.25					
Utica					3,372	3,150			19,534
North Carolina:									
Asheville									914
Marysville							4,000b		
Niles			22,000						23,000 s
Sidney									600 s
Toledo			5,810	29,928	27,329				
Oklahoma:									
Hobart								8a	
Lawton						3,500b		2	1½
Oregon:									
Dallas									86,000 s
Portland		.0113				9,1131			509,175 s
Pennsylvania:									
Bradford			7,000						
Clearfield			10,000						
Corry									935
Erie									32,000
Greenville			2,000						
Hanover							27,000		3,500
Hazelton	10,427						62,244.5		500
Hollidaysburg					2,500				
Jersey Shore									3,000 s
Media									
Philadelphia		5,541	516	831		65	4,50		
Pittsburgh		119,600	35,100			1,240			88,500
Summit Hill								5,300	3,000 s
Warren					3,000				
Woodlawn			13,138						
Rhode Island:									
Newport							2,330		
Pawtucket		13,215					1,006		6,490
South Dakota:									
Aberdeen									2
Sioux Falls						2.70			1½
Watertown								2	1,400
Texas:									
Amarillo									4,000 s
Bonham									
Childress			20,000						¾
Cisco			38,000			7,000			4
Eastland			35,700						

PAVEMENTS LAID DURING 1920 Continued

City and State	Sheet Asphalt	Asphalt Concrete	Tar Concrete	Warrenite-Bithulithic	Bitoslag	Rock Asphalt	Willite	Asphalt Macadam	Tar Macadam
Galveston	.....	.....	6,000	.....	5,880	.....	.....	.....	.....
Vermont:					.....	.....	.....	.....	.....
Bennington	.....	.....	.....	.....	11,000	.....	1.1	.....	.....
Ruthland	.....	.....	.....	.....	1.6	3,467	.....	.....	1,442
Virginia:									
Roanoke	.....	.....	.....	.....	.....	.....	1.1	.....	.....
Washington:									
Auburn	.....	.....	.....	.....	.....	.....	.....	.....	.....
West Virginia:									
Clarksburg	.....	.....	2	.....	.....	3	.....	.....	1¼
Moundsville	.....	.....	.....	.....	.....	3	.....	.....	.....
Wisconsin:									
Ashland	.....	.....	.....	.....	.....	1¼	.....	.....	6
Janesville	.....	.....	10,655	.....	.....	.....	.....	.....	.....
Lake Geneva	.....	.....	.....	.....	6,857	.....	.....	.....	400§
Menosha	.....	.....	.....	.....	6,000	.....	.....	.....	.....
Neemah	.....	.....	.....	.....	16,000	5,029	.....	14,070b	916b
Port Angeles	.....	.....	.....	.....	1.76	.....	.....	.....	.....
West Allis	.....	.....	.....	.....					
Canada:									
Toronto, Ont.	.....	.....	1.37	.....	.....	.....	.26	.....	6.12

¶—Information furnished by manufacturers. §—Vibrolithic. †—Cubic yards. §—Square feet. ‡—700 Topeka on stone base; 3000 on concrete base.]*—5 ft. wide. ††—5381 lineal feet, 30 ft. wide, asphalt filler; 3572 lineal feet, sand filler. § §—Feet. a—Blocks. b—Lineal feet. c—Dollars.

1920 PAVING NOT TABULATED

A few cities have laid pavement or sidewalk not covered by our classification. Among these, Chicopee, Mass., laid 4,664 squares of "national" pavement and relaid 225 yards of stone block pavement; Orange, Conn., laid 3,000 square yards of "national" pavement; Beaver Falls, Pa., did 9,600 square yards of resurfacing with asphaltic concrete on old brick pavement; Danville, Va., laid 8,743 square yards of asphalt surfacing over old cobblestones; Washington, D. C., resurfaced 35,375 square yards of sheet asphalt; Boston, Mass., resurfaced 180,000 square yards of asphalt macadam and 60,000 square yards of tar macadam; Longview, Texas, laid 3,000 square yards of shell surface with asphalt, resurfaced 7,000 square yards of macadam with asphalt and resurfaced 4,000 square yards of asphalt macadam; Fort Myers, Fla., laid 9,000 square of asphalt; Newark, N. J., laid 2,416 square yards of asphalt block; South Orange, N. J., laid 10,046 square yards of asphalt block; Mamaroneck, N. Y., laid 7,930 square yards of Hassam pavement; Watertown, Mass., laid 26,075 yards of gravel treated with oil; Bakersfield, Cal., graded and oiled 57,298 square yards; Portsmouth, N. H., laid four miles of cinder roads; Sharon, Pa., laid 10,000 square yards of slag roads; Port Arthur, Texas, laid 17 miles of shell road with one-inch gravel top; Braintree, Mass., laid one mile of tar sidewalk; Laconia, N. H., laid 1,717 square yards of tar concrete sidewalk; and Springfield, Vt., laid 1,053 square yards of tar-sand sidewalks.

North Carolina's Highway Commission

The new highway law of North Carolina provides for a state highway commission consisting of a chairman from the state at large known as the state highway commissioner, and nine commissioners, one from each construction district, all to be appointed by the governor and confirmed by the senate. (The previous law called for four commissioners.) The act continues Chairman Frank Page in office for his unexpired term, his successor to be appointed for six years. Three of the new commissioners will have 2-year terms beginning April 1, 1921, three will have 4-year terms and three 6-year. The chairman is to give his full time to the work and his pay will be fixed by the council of state. (It was formerly $5,500.). He had all the authority of the commission when it is not in session. The other members receive $15 a day and traveling expenses ($10 was paid formerly) when engaged in carrying out the duties of their office.

The commission is to employ a state highway engineer, whose salary is to be fixed by the commission with the governor's approval, to hold office at the pleasure of the commission but not to exceed 4 years without reappointment. A total of $50,000,000 is authorized for the work. A system of roads to be improved by the state is designated, but these may be changed by the commission on objection by local authorities or otherwise. The first work of the commission is to post at the court house door in each county a map showing the routes adopted, 60 days being allowed for filing objections.

The general purposes as set forth in the opening section of the act, are to take over, establish and maintain approximately 5,500 miles of "hard-surfaced or other dependable highways" running to all county seats and all principal state institutions, and linking up with the state highways of all adjacent states and with national highways, by the most practicable routes, with special view to the development of agricultural, commercial and natural resources.

The funds are to be apportioned among the nine construction districts as nearly as possible on a uniform basis, one-third in proportion to the area of the district, one-third in proportion to the population and one-third in proportion to the highway mileage of the district.

It is declared to be the intention to establish a state system of highways, hard-surfacing them as rapidly as possible and maintaining the entire system in the most approved manner, work on the various lines to be of such character as will lead to ultimate hard-surfaced construction as rapidly as money, labor and materials will permit, and to a state system of durable, hard-surfaced, all-weather roads. All hard-surfaced roads are to be not less than 18 feet wide except in unusual cases.

Recent Legal Decisions

RESOLUTION OF INTENTION TO IMPROVE STREETS HELD SUFFICIENT, THOUGH IRREGULAR

In an action in the Oklahoma courts by property owners to have certain special assessments levied against their property declared null and void, for the reason that the resolution passed by the city commissioners did not declare the work or improvement necessary, the proceedings were controlled by sections 722 and 733, Snyder's Statute of 1909, and it appeared that the city commissioners passed a resolution and published it the required length of time, as required by that statute; the resolution notified the property owners that, if no protest was filed within 15 days after the last publication of the resolution, a contract would be let for the paving and guttering of the street, and no protest was filed by the property owners. The Oklahoma Supreme Court holds, Oliver v. Pickett, 193 Pac. 526, that the resolution, though irregular in form, in not expressly declaring that the improvement was necessary, is not invalid, but sufficient to give the city commissioners jurisdiction to enter into a contract for the improvement, and the assessments made in accordance therewith are valid.

EMPLOYMENT OF ROAD COMMISSSIONER TO SUPERVISE CONSTRUCTION PROHIBITED BY STATUTE

The Arkansas Supreme Court holds, Hill v. Cruce, 225 S. W. 11, that Arkansas Acts, 1915, No. 383, par. 5, requiring from each commissioner of a road improvement district an oath that he will not be interested in any contract made by the board of commissioners, amounts to an express prohibition against his being so interested, and therefore renders invalid a commissioner's employment by the board to supervise road construction. The court considered that the trial court erred in holding a taxpayer not entitled to judgment against the commissioner so employed because it was shown that the contract was an advantageous one to the district. The Supreme Court holds that if the contract is illegal it is unimportant to determine whether it is advantageous or not, as its validity or invalidity is not determined by balancing its advantages against its disadvantages.

AWARD OF PAVING CONTRACT ON INCOMPLETE BID INVALID

In letting a county paving contract to the lowest bidder, under the Nebraska statute, Rev. St. 1913, § 2956, the specifications and proposals for bids called upon each bidder to specify the time when he will agree to commence and when he will complete the work, if awarded the contract, and provided that liquidated damages shall be charged against the contractor for each day's delay in performance beyond the contract time. The Nebraska Supreme Court holds, Root v. Douglas County, 180 N. W. 46, that in such a case the time of performance is an essential part of the bid, and, where omitted, the bid is in complete and not responsive to the proposal. In such event the bid cannot be filled out, nor the time for performance inserted, after it is received and opened by the county board, and an award of the contract to such bidder is invalid.

DISTINCTION BETWEEN URBAN AND INTERURBAN PASSENGER CAR TRAFFIC

The Wisconsin Supreme Court holds, in an action by a city to enjoin an electric railway and light company from carrying on its street railway system interurban passengers and freight, City of Milwaukee v. Milwaukee Electric Ry. & Light Co., 180 N. W. 339, that urban surface street car passenger service is the transportation of passengers in suitable cars over the streets of a city operated so as to permit them to enter and leave the cars at reasonable intervals. The initial point from which the car or passenger comes or the point to which they are destined is immaterial. The criterion is the character of the service rendered by the cars while on the city streets. If that is an ordinary or reasonable street car service as to fitness of car, rate of speed and frequency of stops for passengers to enter and leave, then while on the city streets such service is street car service, though the car may come from or enter interurban service on the same trip. It is also held that as to a given city interurban railway passenger traffic is the transportation between it and other cities or municipalities of passengers without thereby rendering reasonable or the prescribed street car service in such city. In interurban service the streets of the city are used for a purpose foreign to their dedication, by being transformed into a right of way for a commercial railroad which does not render reasonable street service.

WHERE COMPETITIVE BIDDERS REQUIRED TO FURNISH THEIR OWN SPECIFICATIONS FOR PAVING, ASSESSMENT AND CONTRACT ARE VOID

The town of Milwaukee, Ore., proceeded by ordinance under its charter to improve a street by grading and paving, payment to be derived only from assessments on adjacent property. Under the call for bids embodied in the second published notice it abandoned its established plans and specifications on which bids had been invited, and required each bidder to furnish his own specifications, so that the only competition between bidders was that of price. In an action by the lowest bidder to recover damages from the town for its failure to provide a fund to meet the contract price of the paving laid by the plaintiff, it was held, Montague-O'Reilly Co. v. Town of Milwaukee, Oregon Supreme Court, 193 Pac 824, that the proceeding was void and the contract made with the lowest bidder gave it no cause of action. The nature and quality of the pavement to be laid vitally affected the question and should have been specified in advance. The question of sufficiency as to precision of the plans and specifications was not here involved. It was an instance of the total absence of authoritative plans and specifications.

NEWS OF THE SOCIETIES

March 30—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Directors' meeting. Atlanta, Ga. Secretary, James T. Mulcahey, Yonkers, N. Y.

April 1 — VANCOUVER SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

April 11 — HARTFORD SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. City Club, Hartford, Conn.

April 14—SAN FRANCISCO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

April 15 — MERIDEN SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

April 16—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Joint meeting with the Association of Iron and Steel Electrical Engineers. Pittsburgh, Pa.

April 18-23 — UNITED STATES GOOD ROADS ASSOCIATION. Greensboro, N. C.

April 21-22—BANKHEAD NATIONAL HIGHWAY ASSOCIATION. 5th annual convention. Greensboro, N. C. Secretary, J. A. Routree, Birmingham, Ala.

April 22 — REGIONAL MEETING, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting of Atlanta, Birmingham, New Orleans sections. A. S. M. E. Council to attend. Mobile, Ala.

April 22 — METROPOLITAN SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with American Institute of Electrical Engineers.

April 22—BIRMINGHAM SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with Atlanta, Birmingham and New Orleans sections, with members of Council present. Battle House, Mobile, Ala.

April 27—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention. Houston, Texas.

April 27-29—UNITED STATES CHAMBER OF COMMERCE. 9th annual meeting. Atlantic City, N. J.

April 27-29 — BUILDING OFFICIAL'S CONFERENCE. Seventh annual meeting. Cleveland, Ohio.

April 28-29—MID-CONTINENT SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting of Chemical Eng. Societies. City Auditorium or Convention Hall, Tulsa, Okla.

April 29 — EASTERN NEW YORK SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Edison Club Hall, Schenectady.

April 29 — COLORADO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Metropole Hotel.

May 2-4—MISSISSIPPI VALLEY ASSOCIATION. 3d annual convention. New Orleans, La.

May 4-7—NATIONAL FOREIGN TRADE CONVENTION. 8th convention. Cleveland, Ohio.

May 9-11—AMERICAN ASSOCIATION OF ENGINEERS. 7th annual convention. Buffalo.

May 9-12—SOUTHWEST WATER WORKS ASSOCIATION. Shirvin Hotel Headquarters, Oklahoma City, Okla.

May 9-12—SOUTHWEST WATER WORKS ASSOCIATION. Oklahoma City. Headquarters Skirvin Hotel.

May 17-19—NATIONAL FIREMEN'S ASSOCIATION. Twenty-third annual convention. Fort Wayne, Ind.

May 19 — SAN FRANCISCO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

May 20 — AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. 370th meeting. Engineering Societies Building, New York City.

May 23-26 — AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Spring meeting. Congress Hotel, Chicago.

June—CONFERENCE OF MAYORS AND OTHER CITY OFFICIALS, State of N. Y. 12th Annual Conference. Elmira, N. Y.

June 6-10—AMERICAN WATER WORKS ASSOCIATION. Annual convention at Cleveland, Ohio. Secretary, J. M. Diven, 153 West 71st St., New York.

June 7-9—NATIONAL FIRE PROTECTION ASSOCIATION. Annual meeting. San Francisco, Cal.

June 21-24 — AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual and Pacific Coast Convention. Salt Lake City.

AMERICAN ENGINEERING COUNCIL

The Committee on New York State Government Reorganization of the American Enginering Council of the Federated American Engineering Societies declares in reports to the chairman of the Joint Judiciary Committees of the Senate and Assembly that any corporation or business interest would go into bankruptcy if its affairs were conducted as are those of the state of New York.

The report, after a careful study of the whole problem, and particularly its engineering aspects, urged the passage of the three state reorganization amendments for consolidation of state departments, an executive budget system and a four-year term. Duplication and lapse of work, as also waste and delays due to lack of responsibility should be prevented. All work of a similar character should be under one department. Departments can be subdivided into bureaus to handle their work, but bureaus should not be duplicated. Departments of public works and of conservation would be most important divisions of the state government.

A large proportion of the expenses of the state are incurred for public works. It is absolutely necessary that work done should be grouped into departments. Both engineering and architectural functions should be grouped under the Department of Public Works where they can be systematically and efficiently managed without duplication and waste of public funds.

Great economies can be attained through the Departments of Public Works and of Conservation. If large enterprises are to be handled efficiently it is of vital importance to have one man in authority with respect to policy, finance, labor, materials and other controlling items, who can be reached without delay. To correct the evils caused by the present unsystematic methods, there is a strong demand for retrenchment, and to secure this result, a complete budget, prepared by the governor and embodying a plan of proposed expenditures, would be most effective.

PERSONNEL RESEARCH FEDERATION

Under the auspices of the National Research Council and Engineering Foundation, the Personnel Research Federation was organized March 15 to bring about interchange of research information among the 250 organizations that are engaged in personnel research in the United States. The Personnel Research Federation will collect research information, will encourage research through individuals and organizations and will co-ordinate research activities.

The temporary officers elected were: Chairman, Robert M. Yerkes, representing National Research Council; vice-chairman, Samuel Gompers, representing American Federation of Labor; treasurer Robert W. Bruere, representing Bureau of Industrial Research; secretary, Alfred D. Flinn, representing Engineering Foundation; acting director, Beardsley Ruml, assistant to the president of Carnegie Corporation of New York.

BROOKLYN ENGINEERS' CLUB

The informal library meeting on March 17 was devoted to a continuation of the "Discussion of the Brooklyn Transit Situation," led by Hon. Henry H. Curran, president of the Borough of Manhattan, and Hon. Herman A. Metz, former comptroller of the City of New York.

NEW YORK SECTION AMERICAN SOCIETY OF CIVIL ENGINEERS

A regular business meeting was held March 16 at the Engineering Societies Building.

"Streets and Parks of the Metropolitan District" were discussed by Charles Wellford Leavitt, landscape engineer, who introduced the subject, and by a number of other speakers. Among those invited to participate in the discussion were F. D. Gallatin, commissioner of parks, Borough of Manhattan; Jay Downer, engineer and secretary, Bronx Parkway Commission; Amos Schaeffer, consulting engineer, Borough of Manhattan; Frederick S. Greene, former commissioner of New York State Highways; Palmer Campbell, park commissioner, Hudson County, New Jersey; Charles Whiting Baker, member, Palisades Park Commission; Arnold W. Brunner, architect, president, Fine Arts Federation; George B. Ford, consultant to City Planning Commission, New York City.

MINNESOTA SURVEYORS' AND ENGINEERS' SOCIETY

This society at its convention in St. Paul on February 21-23 ratified the constitution of the proposed Minnesota Federation of Architectural and Engineering Societies and raised the dues to take care of this additional expense. It also endorsed the proposed registration law for architects and engineers.

ENGINEERING SOCIETY OF WISCONSIN

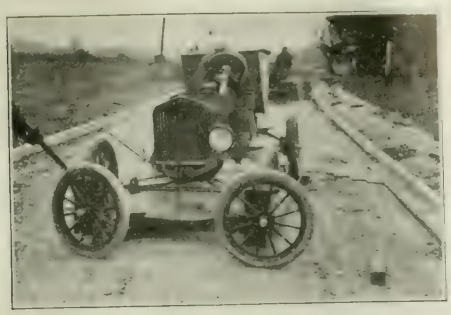
At its annual meeting in Madison on February 21-23, the Engineering Society of Wisconsin elected as president Prof. C. I. Corp, and as vice-president, Jerry Donohue. Resolutions were passed advocating that the state legislature compel the licensing of engineers, that a college of agriculture be established at the state university and that the St. Lawrence river be deepened for the use of ocean liners.

WISCONSIN STATE DRAINAGE ASSOCIATION

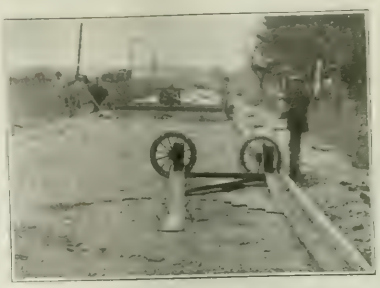
The Wisconsin State Drainage Association has elected the following officers: President, G. R. Hall; vice-president, Jerry Donohue; treasurer, Anton Brost; secretary, Prof. E. R. Jones; and assistant secretary, O. R. Zeasman.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



TRUCK BEING REVOLVED ON TURNTABLE



TURNTABLE INSTALLED ON SUB-GRADE

HUG TRUCK TURNTABLE

The Hug truck turntable, invented, adapted and manufactured by the Hug Lumber & Construction Company, is designed to turn trucks on the sub-grade of a highway between the concrete road forms. It is a light, portable apparatus built in two sizes for 1-ton Ford trucks or for 2 or 2½-ton trucks and can easily be shifted by two men as the work advances.

In operation, the truck is run onto the turntable till the truck wheels strike the bumper and one of the rear wheels, driving on the ground, revolves the turntable by the power of the truck engine. A loaded truck can thus be revolved 180 degrees in 8 seconds and the turntable switched back to original position by one man. It very much expedites the delivery of materials to the concrete power mixer and facilitates passage of trucks on the sub-grade, the turntable being placed at one side of the roadway to give clearance beyond it.

HOLT CATERPILLAR TRACTORS

Holt caterpillar tractors are made in 5-ton and in 10-ton sizes and have a draw-bar h. p. of 25 and 40, respectively, at a speed of 3 miles per hour. The weights are 9,400, 19,000 pounds and they are especially recommended for road work, particularly for hauling cranes or wheeled scrapers.

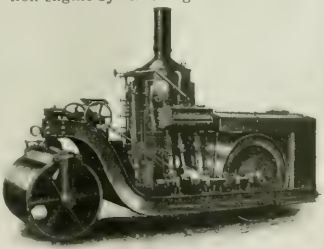
A 5-ton caterpillar tractor with three men will handle more dirt in one day than eight or ten good teams. It loads at a speed of 1.57 miles per hour, hauls the loading scraper at a speed of 3 miles per hour and returns the empty scrapers at a speed of 5.71 miles per hour.

A time schedule for a 5-ton machine hauling four 2-wheel scrapers 150 feet gives the trip time as 3 minutes and 5 seconds and the yardage as 390 in 8½ hours. Hauling one mile the trip time was 32 minutes and the yardage 38. These results included more than 15 per cent allowance for lost time.

One operator with two 5-ton caterpillars, six 2-wheel scrapers and four men handled an average of 400 yards per day to a distance of 12,000 feet.

MONARCH ROLLERS

The Good Roads Machinery Company, Inc. catalog of Monarch steam road rollers illustrates and describes the principal features of the 10 and 12-ton steam road rollers with two speeds, differential gear and high steam dome. They are provided with 48 detachable picks for use on worn stone roads and streets and with a belt wheel for operating a stone crusher. They can climb a 20 per cent grade and are efficient as traction engines. The roller is easily and quickly transformed to a traction engine by removing the two middle front rolls, replacing them with a spreader, and adding traction cleats to the rear drivers. They can be equipped with a scarifier attachment having nine heavy manganese steel teeth that may be adjusted to any definite cuts of 1 to 6 inches.



ROAD ROLLER, SCRAPER AND TRACTOR

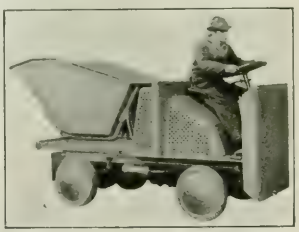
The Monarch tandem roller is built in 6-ton and 9-ton sizes, and has a steering device that consists of an oscilating steam engine by which the rear rollers can be set to the desired position before starting to roll.

MUSHROOM TRAFFIC LIGHT

Milwaukee Mushroom traffic light, manufactured by the Electrical & Specialty Company, is designed for installation in the pavement or roadway, and is provided with a very strong spherical segmental shield that deflects or supports front wheels without injury. It provides a signal that is easily visible by day or by night, that is unaffected by rain or snow, requires no replacement, and does not damage automobiles or jeopardize life or property. It eliminates the collision hazards of the old type stand signal.

POWEROX INDUSTRIAL TRACTOR

The Powerox, manufactured by the Barrett-Cravens Company, is a 4 x 8-foot tractor designed for heavy duty in factory or inter-plant service and for light to medium construction work where a very small unit is needed. If used as a carrier it will transport 3,000 pounds and as a tractor will pull 40,000 pounds. The engine clutch and transmission form a unit power plant located in front and with the radiator in its rear and power is applied to its rear wheels through a worm gear drive, rear axle fully enclosed. It has a front wheel steer and short wheel base, giving a very short turning radius. Many types of bodies can be supplied and information is given on demand.



TRACTOR AND CARRIER

STEEL ROAD FORMS

A 16-page booklet has just been published by the Lakewood Engineering Company, Cleveland, describing the Lakewood-Hotchkiss line of steel forms for road, sidewalk, curb, gutter, culvert, foundation and wall construction. It is profusely illustrated and shows the application of the Lakewood-Hotchkiss method of construction, which is claimed to secure better concrete and perfect expansion joints.

INDUSTRIAL NOTES

ASH BARREL RETURNER

A push cart manufactured by J. T. Lynch for returning empty ash receptacles from the curb to the rear of premises has a curved frame work which will hold three of the largest sugar barrels in a row and three smaller barrels can be placed inside them. This returner has been loaded in service with eleven miscellaneous kinds of ash receptacles at one time. There were all shapes and sizes from regular barrels to wash tubs, baskets and boxes.

BARREL RETURNER CARRYING 7 RECEPTACLES

In cities where receptacles are not restricted there are about 14 different kinds of receptacles commonly used and 30 or 40 others used to some extent. This "returner" takes them all.

The illustration shows the returner loaded with 7 receptacles—2 barrels, 3 tubs and two baskets. One man can push it easily with one hand as it has rubber-tired wheels and can be pushed, when loaded, by one man with one hand. The two pilot wheels are needed only when loading the "returner" or in going down steps and terraces.

The iron frame is built of angle iron and the curved portions are well braced and rigid. It is 6½ feet long and weighs only about 50 pounds. The usual load is not over 70 or 80 pounds. One man with this returner can do the work of two men without it.

GIANT MINE CARS AND WHEELS

The 2-ton Giant mine cars made by the Judy Manufacturing Company are of all-steel, sturdy, compact, construction suitable for tunnel service and are mounted on Giant roller-bearing wheels of special type in which all of the moving parts are inside a grease chamber, reducing friction to a minimum and preventing waste of oil or grease. The solid roller bearings are dirt and waterproof and are held in position by a simple positive lock.

COAL TAR PRODUCTS

Lewis road tar and Lewis improved coal tar pitch filler, manufactured by the S. J. Lewis Manufacturing Company, are extensively used for road pavements in many places.

The specifications for Lewis road tar pitch require a specific gravity between 1.22 and 1.28, a melting point of not less than 100 degrees Fahrenheit, installation temperature of not less than 328 Fahrenheit and a carbon of not less than 12 per cent or more than 25 per cent.

CONWAY ASPHALTUM PRODUCTS

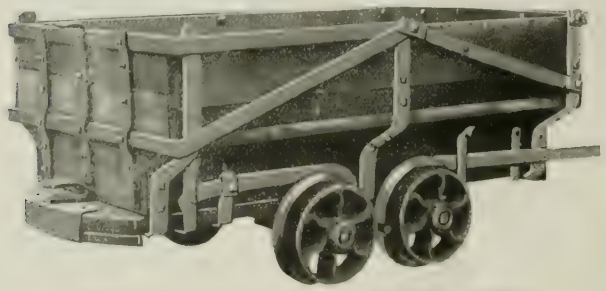
Asphaltum paint and products manufactured by the R. S. Conway Company, refiners and shippers of natural asphalt, are prepared to meet the requirements of road builders, pavers and builders and are offered for use as asphalt fillers for brick, creosoted block and granite pavements and for expansion joints, for penetration road work and for the preservation of wood and metal and for waterproofing concrete walls, cisterns, vats, pipes and other uses. They are extensively used in the city of Chicago and in many other municipalities.

CHICAGO INCINERATOR CO.

The Chicago Incinerator Co., erectors of the B. E. E. & Goeder incinerators and furnaces for low-grade fuel and factory waste, have removed their offices from 320 East North Water street to 2131 South Turner avenue, Chicago.

DWIGHT P. ROBINSON & CO. INC.

Dwight P. Robinson & Company, Incorporated, a large firm of engineers and constructors of New York, has recently opened branch offices in Montreal in the Dominion Express building. Alexander C. Barker, vice-president, is in charge of the office. The company is a consolidation of Westinghouse-Church, Kerr & Co., Inc., and Dwight P. Robinson & Co., Inc.



2-TON TUNNEL CAR WITH ROLLER BEARING WHEELS

PERSONALS

Philips, Hiram D., assistant division engineer of the Massachusetts State Department of Public Works, Bureau of Highways, has been appointed engineer of District 2, Franklin and Hampshire counties, Conn.

Scheible, Charles F., has been appointed Director of Public Service, Youngstown, Ohio.

Marks, Major Edwin H., is now in charge of the division of engineering in the area of Duluth.

Hoffeditz, W. L., paving engineer, of Twin Falls, Idaho, has been appointed city engineer of Colorado Springs, Colo.

Elder, Donald C., has been appointed engineer of Marshall county, Iowa.

Smithley, Charles, has been appointed engineer of Geary county, Kansas, to succeed G. A. Russell, who has resigned.

Tripp, Robert D., formerly city manager and engineer of Petosky, Mich., has been engaged as road engineer for Emmett county, Mich.

Reed, William B., of Weedsport, N. Y., has been named third deputy commissioner of highways with headquarters at Albany. He is succeeding Charles Van Amburg, of Binghamton.

Mieron, Frederick C., an engineer with the New Jersey State Highway Commission, died on January 19 at Lakewood, N. J.

Garvin, Samuel H., has been appointed city manager of Bowling Green, Ky.

Hambrecht, Albert L., was appointed State Division Engineer of Division No. 1, Wisconsin Highway Commission, with offices in Madison, to succeed W. C. Buetow, who is now at the main offices of the Highway Commission.

Mahnke, Edward, has been re-elected building commissioner of the city of Waterloo, Iowa.

Rogers, C. J., has been appointed county engineer of Jefferson county, Ala.

Lemmon, Major G. T., formerly resident engineer in charge of the work in 13 counties of the Virginia State Highway Commission, has been transferred to Richmond, where he will be in charge of 15 counties.

Eckart, Nelson A., has been appointed chief assistant city engineer of San Francisco, to succeed Mr. Cleary.

Boone, Louis C., of Rowesville, S. C., has been appointed engineer of Orangeburg county, S. C.

Owens, T., has been appointed city engineer of Port Angeles, Wash.

Barnard, Edward D., commissioner of the International Boundary Commission, died in Washington on February 6.

Fisher, James F., formerly engineer of Williamsport, Pa., died on February 5 at Muncie, Ind.

Taylor, Major Clyde V., has resigned from the United States Indian Irrigation Service with which he served for six years, and will engage in private engineering practice at Reno, Nevada.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879.

Vol. 50 **FLORAL PARK, APRIL 2, 1921** **No. 14**

Costly Railroad Re-location

Shifting 15 miles of double-track railroad around Huffman dam, Miami Conservancy District, required excavating 657,000 yards, mostly rock in one cut 120 feet deep, placing 390,000 yards of embankment, cost more than $3,237,000.

SHOWS THE FULL SCOPE OF THE WORK OF EXCAVATION, WITH TWO WELL DRILLS IN THE FOREGROUND AND THE STEAM SHOVEL, DUMP CAR TRAIN AND INGERSOLL ROCK DRILLS IN THE BACKGROUND.

The $25,000,000 flood protection works in the Miami valley, Ohio, that are now in an advanced stage of construction by the Miami Conservancy Commission, include the Huffman dam, an earth embankment 65 feet high, 3,340 feet long and nearly 400 feet wide at the base, which contains 1,547,000 yards of earth and, impounding the drainage area of 671 square miles, forms a retarding basin that has, in a flood like the disastrous one of 1913, a submerged area of 7,300 acres and retains 124,000 acre-feet of water with an average maximum depth of 17 feet and a possible maximum depth much greater.

The dam is built across the valley of the Miami river at a point about 6 miles above the city of Dayton and at a point where there were located the two double tracks of the Erie and Big Four Railroads at an elevation about 60 feet below the top of the dam.

DIVERSION AND ELEVATION OF TRACKS

Both roads have large and costly yards in Dayton, the elevations of which could not be changed, and as the greatest permissible grades from these yards would not bring the track level within 35 feet of the top of the dam at the dam site it was necessary to divert the alignment of both roads to a point beyond the end of the dam. This necessitated a long, deep cut through the rocky hillside, beyond which the still ascending tracks continued for a long distance, below the level of the flow line in the reservoir, making it necessary to protect the tracks by very heavy levees on both sides to exclude, in time of flood, the water that will then fill the basin through which the tracks pass.

The two double-track systems are combined to form a single four-track system for the purposes of re-location, and were built 14 feet apart on

centers for the first 7 miles from Dayton to a point a mile beyond the dam, where the distance between tracks is increased to 60 feet to the end of the re-location, which is about 15.22 miles long. The tracks are run on a grade of 0.3 per cent to a point in the retarding basin beyond the dam, where they reach the elevation of the flow line. The new location is nearly 8,000 feet longer than the original location of the two double-track systems, and it also involves an increase of 93 degrees in curvature and a considerable increase in grades, which with operating expenses, together with some other items of maintenance, are capitalized at $579,974. This sum added to $2,717,120, makes a total charge to the Conservancy District of $3,237,094, exclusive of the cost of right-of-way amounting to 345 acres.

HUFFMAN DAM CUT

The principal feature of the re-location is the deep cut in which the tracks pass about 400 feet south of the south end of the dam and at an elevation 35 feet below its crest. This involves a rock cut 120 feet in maximum depth, 4,500 feet long, 72 feet wide at the bottom and very much wider at the top, where about 54,000 yards of earth were excavated. The remaining 593,000 yards of spoil was rock, consisting of a 35-foot stratum of Brassfield formation, 44 feet of Elkhorn and 41 feet of Cincinnatian formation.

All of the rock was drilled by five Ingersoll-Rand E-44 steam drills, four well drills and two jackhammer drills. The rock drills averaged 60 to 65 feet of 3¼ to 3½-inch holes in each 10-hour shift. The well drills averaged to 40 to 50 feet in 10 hours. About 90 per cent of the holes were sprung and then charged with from 100 to 250 pounds of 45 per cent Du Pont or Aetna dynamite, which was used after so many springs had been encountered that the original use of ammonia dynamite was superseded.

The Brassfield stratum was sufficiently solid to be excavated on a 1:1 slope with a 8-foot berm at the foot. The Elkhorn stratum, which is much softer, was greasy and was excavated on a 1½:1 slope, with a 4-foot berm at the foot. This could have been accomplished by the steam shovel without blasting, but the rock was so tough that blasting was economical. The Cincinnatian formation consisted of layers of limestone separated by laminations of shale, which when first exposed was hard, but softened and sloughed so rapidly by exposure that in a month it could be picked to pieces. It was excavated on a 1:1 slope.

BLASTING

The blasted rock was handled by two 70-ton C Bucyrus steam shovels working together one 10-hour shift, and by one of these shovels working continuously day and night. The shovels handled an average of about 4,000 yards each per 10-hour shift, loading it into standard gauge 12-yard Western dump cars hauled by locomotives and used for making the embankment and levees.

When the steam shovel was operated on the same level as the dump cars, the rock was excavated in 16-foot lifts and the holes were spaced 13 feet apart. When the cars stood on the lift above the steam shovel track, the rock was excavated in 8-foot lifts in which the holes were spaced about 7 feet apart. At the bottom of the cut the last lift was 28 to 30 feet high and 2,500 feet long.

Enough explosive was used to shatter the rock and throw it into a long windrow, which was removed by the steam shovels traveling from end to end and loading it into dump cars alongside. The excavation was made by the Walsh Construction Company, Davenport, Ia., under the superintendence of W. A. Durkin and was accomplished without serious injury of any of the employees.

EMBANKMENTS

The grade between Dayton and the dam is wholly in embankment which required 106,000 yards more material than was available from the cuts. The construction of the levees also required so much embankment that the embankment and fills for the total job were unbalanced by an amount of 400,000 yards, most of which was secured by increasing the width of the cut and the remainder by opening borrow pits.

Between Dayton and the dam two railroad bridges were eliminated by the construction of a cut-off channel in the river which required the excavation of 34,000 yards of material by clamshell buckets and 10,000 yards by teams and scrapers.

On the upstream side of the dam there are twin levees 200 feet apart, 35 feet in maximum height and 1½ miles long, together requiring 469,000 yards of embankment, nearly three-fourths of which were taken from the Huffman cut. About 40,000 yards were furnished by excavating between the levees with an elevating grader and dump wagon for the sub-grade of the railway tracks. For 3 miles the embankment in wet, miry soil was obtained by side borrow with elevating grader, constructing a narrow embankment which was afterwards widened by side dump from cars hauling spoil from the steam shovels in the cut.

TRACK LAYING

The tracks were laid with 90-pound rails and creosoted 7 x 8-inch ties 8½ feet long and 18 inches apart on centers. Standard tie plates are used on all curves and the road is ballasted with gravel having a minimum thickness of 12 inches below the bottoms of the ties and requiring 3,490 cubic yards per mile of single track.

Because it was necessary to shift the original location of the tracks near the dam in order to commence construction on the outlet conduit at the earliest possible date, a preliminary re-location about 1⅓ miles long, was made which required 33,800 yards of rock excavation and provided for traffic during two years before the permanent re-location was completed.

The work was done by contract and was executed under the supervision of railroad engineers and of the division and the assistant engineers of the Conservancy Commission, of which Arthur

E. Morgan is chief engineer and Charles H. Paul assistant chief engineer. It was described in the "Miami Conservancy Bulletin" for October, from which the accompanying illustrations are reprinted.

Sand Filters for Small Sewage Plants

By W. A. Hardenbergh

When suitable; construction requirements of several state health boards.

In a recent issue the disposal of the effluent from residential and other small sewage treatment plants by means of sub-surface irrigation was discussed at some length, and the recommendations of various state boards of health were given.

Under certain conditions this method of treatment is best suited for residence and small community use. These conditions include a well-laid distribution area and a porous soil. The latter, unfortunately, cannot always be secured, and costly substitutes must be found. Also, in the case of institutions using fairly large quantities of water, a considerable area is required. Finally, the effluent is applied to the soil in the manner best suited to cause pollution of ground water.

Intermittent sand filtration yields very good final effluent; but considerable care is necessary for proper operation. Where this care can be secured, the small sand filter will prove most satisfactory. The only local necessity is sufficient fall to allow the filter to operate. With the ordinary septic tank, siphon and sand filter, about 5 feet of fall is usually needed. The presence of local sand supplies will reduce the cost.

The Illinois State Board of Health does not recommend the use of the sand filter in cases where less than 25 people contribute sewage. A depth of sand of three feet is recommended, with a carefully constructed underdrain system of drain tile and graded gravel. The area of the installation is figured on the basis of one acre for every 750 people. This would give about 1,450 square feet for the minimum installation of 25 persons. Three beds are recommended, allowing the use of two beds alternately, while the third is being cleaned, repaired or rested.

Particular attention is called to the necessity of supervision. The beds should be visited every few days. At intervals of a month or so it becomes necessary to rake or scrape the bed slightly, so as to break up the surface mat. Furrowing or covering may be necessary in cold climates in the winter.

The Public Health Service has published in Bulletin No. 101 the result of investigations of house and small community sewage disposal carried on by Frank and Rhynus. The recommendations given here are: Thirty square feet per capita of sand beds for flows of 20 gallons per person per day; forty-five square feet of sand beds per capita for flows of 100 gallons per person per day, with proportionate areas between these extremes. The filter depth is suggested as not less than 24 inches. As high as 36 inches may be of advantage where the head is available, as this additional height allows removal of surface layers while cleaning. The effective size of the sand should be from 0.3 to 0.5 mm. and the uniformity coefficient not more than 4. The underdrainage should be a four-inch layer of broken stone or gravel, one inch to two inches in size, supporting a 2-inch layer of broken stone or gravel one-fourth to three-fourths inch in size.

Covers are recommended for these small beds. This will prevent growth of vegetation in warm weather and the formation of ice in cold weather. Inspections should be made every month, but the beds should not require raking more than three or four times a year.

The Wisconsin State Board of Health illustrates in their publication a filter from 2 to 3 feet in depth, and recommends a surface area of 20 to 30 square feet per person, depending upon the flow, character of the filter, etc. This bed is underdrained with open-joint tiling. Distribution on the surface of the filter is by troughs laid with a fall of 1 inch in 50 feet, and provided with outlets at intervals of 10 or 12 inches. The troughs are 4 inches wide and 3 inches high and have ¾-inch outlets. Weekly alternation in the use of beds is considered essential.

The Ohio State Board of Health suggests the use of from 24 to 30 inches of sand of a grade similar to that required for mortar. It "should be of good uniformity, clean, and free from loam, and for best results should have an effective size of from 0.3 to 0.45 mm." The bottom of the beds should be sloped to the center, and about 6 or 8 inches of gravel placed around the underdrains. The lower layer of gravel should range in size from one-quarter to one inch, above which should be placed a 2-inch layer of pea-size gravel to prevent the washing of the finer filter sands into the underdrains. The uniformity coefficient of the sand should be from 1.5 to 2.5, according to this authority.

The area of the beds is determined upon the basis of 100,000 gallons per acre per day. This allowance figures out to be about 22 square feet of filter surface per person. For the larger installations, two alternating siphons should be used, but in single residences this is scarcely necessary. Distribution is through a 6-inch tile line which has an outlet on an apron at the center of each bed. In the case of the larger beds, where equal distribution cannot be secured from one point, troughs may be used.

In the case of sand filter installation, operating care and maintenance are the prime requisites. Without proper care and maintenance, the intermittent sand filter will not work, whether the installation be large or small. On that point alone are other methods of small plant disposal superior. From the standpoints of cost, quality of effluent and universal adaptability, the sand filter is far superior to other methods.

Work on the $100,000,000 Welland Ship canal is to be resumed by the contractors, it is reported. In 1917 it was taken from the contractors and stopped, but later resumed on a cost-plus basis.

Water Rates in Small Minnesota Villages

Method employed in fixing the meter rates in a village of 3,500 population.

A paper entitled "Water Rates in Small Cities and Villages" was read before the Minnesota section of the American Water Works Association by John Wilson, consulting engineer of Duluth, in which he described the method employed in fixing the rate of the village of Crosby, Minn., a village with a population of about 3,500. The water works plant was installed in 1911 by a private company and taken over by the village in 1918. On taking over the plant the village decided to determine by scientific methods what would be a proper and fair schedule of rates.

The first step was to determine what amount should be chargeable to the village at large, this including fire protection. It was estimated, by careful consideration of all features, that 51.6 per cent of the appraised value and 45.9 per cent of the cost of extensions to be made might justly be charged to fire protection. (The assessed value was $75,680 and $56,000 was spent in extending distributing mains and additional fire hydrants.) For reasons of policy as well as equity the village decided to pay for installing meters and laying connections from the main to the curb box, this cost to be considered in calculating the service charge. Service charges were fixed at 40 cents per month for ⅝-inch meters, 75 cents for ¾-inch and so on up to $12 for 4-inch. Estimating the number of meters of the several sizes, it was then possible to determine the fixed amount which the village would obtain from its commercial service.

An estimate was made of the number of cubic feet a year that would probably pass through the ⅝-inch meters and that which would pass through the larger ones, the amount which would pass the meters without registry and that which would be used for street sprinkling and other public uses, including fire extinguishing. It was clear that the amount measured by meters and that passing the meters without registry should be paid by the water consumers; that the amount used for extinguishing fires should be charged to fire protection, and that the remainder should be charged to the village at large. Such items as clerk's salary were all charged to domestic service, while the fire service was charged with its share of interest on bonds, maintenance of fire hydrants, etc., In lieu of any figures available for determining the amount of water that would be pumped and unaccounted for, this amount was assumed at 40 per cent.

The total annual expense of the department was then estimated, this including 6 per cent interest on the bonds and on other indebtedness, the amount of the clerk's salary chargeable to the water department, the superintendent's salary, labor, office supplies and postage, fuel, meter repairs, maintenance and depreciation, electric current, insurance and telephone. The total was $14,857.

A considerable part of the cost of extensions had been incurred because of requests of citizens whose private wells had been destroyed by mining operations. Moreover, it did not seem just to place all of this additional expense on such consumers as the village already had, it seeming proper that the plant should operate at more or less financial loss while establishing the business. It was therefore decided to deduct $1,700 a year from the return on these extensions chargeable to the commercial consumers and add it to the amount to be borne by the village at large.

There resulted from the above considerations a payment for fire protection of $5,925; water used by the village at 18 cents per hundred cubic feet, $1,000; and the $1,700 just mentioned; a total paid by the village of $8,625. This left $6,232 to be derived from the private consumers. The service charges would yield $2,161, leaving $4,071 to be raised by meter charges. It had been estimated that the amount of water used by the private consumers would total about 1,628,500 cubic feet, and this gave a meter rate of 25 cents per hundred cubic feet, which was the rate adopted. The calculation resulted in a payment by the village of 58 per cent of the total annual expense and by the water consumers of the remaining 42 per cent. It is interesting to note in this connection that the Wisconsin commission ruled that in the case of Ashland the city should pay 54.5 per cent of all fixed charges, and that in the case of Ripon the city should pay 75 per cent.

Mr. Wilson referred to some features of rates throughout the state and, among these, noted that hydrant rentals in the state ranged all the way from $4 per hydrant per year to $140, while 57 per cent of the water plants of the state received nothing whatever from the municipality in the way of hydrant rental or payment for fire protection. (There are 202 water works plants in the state, of which only 7 are privately owned.)

The rates in most cases are on a sliding scale, the most extreme case being a town with a little over 3,000 population where there are 21 different rates for water and 20 different rates of discount for payment of bills, giving a possible separate combination of water rate and discount rate for almost every consumer.

Duluth Water and Light Notes

In his report for the year 1920 of the water and light department of Duluth, D. A. Reed, manager of the department, states that during that year the consumption of gas was 20.2 per cent greater than that for 1919, while the increase in number of customers was only 8.2 per cent. The only explanation offered was the tendency of the people to be more liberal in their expenditures.

The gas supplied by the city is obtained from

the Zenith Furnace Company, whose plant is in West Duluth. It is transmitted the full length of the city through high-pressure mains, from which it is discharged into low pressure distributing mains at various points through regulating governors.

Duluth has an interesting method of assessing for extensions of its water and light distribution systems. In 1914 the city began making extensions on the basis of assessing 8 per cent of the cost annually against abutting property, while one-half of the amount which said property pays for water and one-third of the amount which it pays for gas are credited to the assessment. If there is no consumption of water or gas the property pays the department a straight 8 per cent annually for not exceeding fifteen years, which takes care of the interest on the investment, depreciation and a small amount for maintenance, but returns very little, if any, on the principle. Of seventeen extensions made in 1914, six no longer have to pay assessments, the revenues being sufficient to more than balance the 8 per cent. Of those made in 1919, however, the assessment amounts of $5,629 were practically all paid, the amounts actually assessed in 1920 being $5,280.

Repairing Water Works Steam Pump

An unusual welding repair on a large cast steel hydraulic cylinder of a steam pump operated by the city of East Liverpool, O., water works and filtration plant is reported by the Metal and Thermit Corporation, New York City.

The casting having developed a 20-inch crack, an attempt was made to repair it by oxy-acetylene welding, but another crack developed as a result of contraction strains and the cylinder was then welded by the thermit process.

The broken sections were lined up together, leaving a small gap between them to provide space for the thermit steel. Yellow pattern wax was inserted in the gap and a mold formed around the wax. A pre-heating torch was then directed into the mold, drying it, burning out the pattern wax, and pre-heating the sections to be welded.

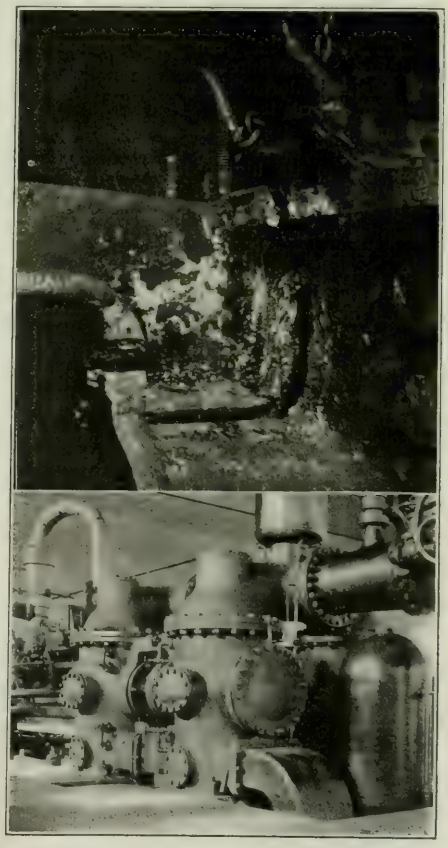
When the sections were heated sufficiently, a charge of thermit (which is a mixture of iron oxide and aluminum) was ignited in a crucible suspended over the mold. The chemical reaction was started at the extremely high temperature of about 5,000 degrees Fahrenheit, during which the aluminum combined with the oxygen of the iron oxide to form aluminum oxide or slag in a highly super-heated molten state, while the iron was set free and produced as liquid steel. This reaction required only about 35 seconds, at the end of which time the liquid steel was tapped from the crucible into the mold, and these amalgamated thoroughly with the broken surfaces of the two sections.

The metal of the weld was allowed to cool slowly, after which the moulding material was removed, the excess metal cut off, and the welded cylinder returned to service where it is giving perfect satisfaction while being operated constantly under a pressure of about 130 pounds per square inch pumping filtered water to a reservoir.

Belt Conveyors for Aggregate

The Barney Ahlers Company, New York, installed a duplex belt conveyor system for transporting, elevating and storing aggregate for concrete construction at Montville, Conn. As the aggregate was delivered by barges that on account of shallow water could not approach within 100 feet of the shore line, and as the site itself was too soft and marshy to permit tracklaying or road-building on its surface, a pier was built at right angles to the shore line and at the extremity the barges were unloaded by a clamshell bucket and derrick delivering to the hopper of a 125-foot conveyor belt ascending at an angle of 20 degrees and delivering to the top of a circular storage pile with a loading tunnel underneath.

In the loading tunnel there was installed a second inclined belt conveyor 279 feet long extend-



CUT AT FRACTURE PRELIMINARY TO WELDING
STEAM PUMP WITH WELDED CYLINDER IN OPERATION

ing at right angles to the first conveyor, obliquely intersecting the shore line, and filling a storage bin on the deck of a sunken barge located in the water opposite the construction work and entirely outside of the working area. The bin delivered by gravity to the mixer and the concrete was hoisted by a tower installed on the barge, and then spouted to the forms.

Effect of Cal in Portland Cement

Result of an investigation by the Bureau of standards indicates acceleration of setting without reduction of the ultimate strength.

With the introduction of more rapid methods of construction and the increasing amount of concrete repair and replacement work, the need for a material for accelerating the hardening of Portland cement has become more pressing, and considerable attention has been given it, notably by the United States Bureau of Standards, which found calcium chloride the most effective of the various substances tested.

Inasmuch, however, as the use of commercial calcium chloride in concrete is attended by difficulties due to its highly hygroscopic nature, Charles Catlett conceived the idea of introducing the salt by means of Cal, which material possesses possibilities even greater than those of calcium chloride, since upon decomposition by water, its products are calcium chloride and calcium hydroxide, equivalent to calcium chloride and finely hydrated lime. And since both these materials are now being used separately to advantage in cement mixtures, it was not considered that the use of Cal introduces any novel feature in the making of concrete except the manner in which these materials are added.

Accordingly, an investigation was inaugurated by Mr. Catlett, with the co-operation of the Bureau of Standards, to study the effects of Cal on Portland cement mixtures, the most important object of this being to learn the value of Cal as an accelerator of the hardening of concrete. The following is an abstract of a report recently issued by that bureau as a result of the investigation:

Cal is a dry, white powder obtained by pulverizing the dried or undried product resulting from a mixture of either quicklime or hydrated lime, calcium chloride, and water. It may be handled in much the same way as hydrated lime and has the same general keeping qualities and is much more convenient to handle and use in making concrete than calcium chloride, either fused or in concentrated solution. Cal, upon exposure to the air, gradually takes up carbon dioxide and becomes somewhat damp. Tests show, however, that long exposure does not affect its action as an accelerator of the hardening of Portland cement mixtures.

The setting of normal Portland cement mixture may be hastened to a great extent by the use of Cal. This hastening of the set is particularly desirable in concrete construction requiring a finished surface, and is not objectionable in any type of construction provided the concrete is placed soon after it is gaged with water. It is believed that Cal increases the workability of Portland cement mixtures. No attempt was made, however, to measure the extent of this effect, because up to this time no satisfactory test has been developed for measuring the workability of Portland cement mixtures.

It has been shown that unsound cements may be greatly benefited or made sound by an addition of Cal, which effect was produced in neat pats subjected to the steam test and in mortar test pieces stored in air.

Limited tests show that quick-setting cements, whether fresh or having become quick-setting on ageing, may be made normal by the addition of Cal as used in cement mixtures.

There was no indication that the amount of efflorescence appearing on the surface of cement mixtures exposed to the weather is increased by the use of Cal.

Tests have been made of the effect of Cal on steel reinforcing bars which were embedded in a thin layer of Cal cement mortar and exposed to the weather for 8 months without corrosion; but these tests, while favorable, are insufficient to give assurance that corrosion will not occur under these conditions. Care must therefore be taken in the use of Cal in concrete containing steel reinforcement when the concrete is to be freely exposed to the weather or excessive dampness, though in ordinary building construction no bad effect is believed to result.

Undried Cal mixed with Portland cement causes a greater deterioration of the quality of the cement during storage than ordinarily takes place. Cal, therefore, should be added to the concrete materials during the mixing operation, preferably before the water is added.

Calculations made from tests in which the test pieces were stored in water, damp sand or damp closet, showed that all Portland cement mixtures treated with Cal attained greater strength at the 2-day and 7-day periods than the corresponding untreated mixtures. The increase in the strength of mortar at the 2-day period obtained by the addition of 5 per cent Cal to cement ranged from 40 to 140 per cent. The strength of the treated mortar at 2 days was equal to that of the untreated at 3½ to 8 days.

Treated mortars stored in the laboratory air attained at 2 days strength greater than that of the untreated mortars at 28 days, due to the rapid drying out of the small test pieces and the comparatively slow rate of gain in strength after the 2-day period. This shows Cal to be especially advantageous in cement mixtures which are necessarily subjected to any drying-out action.

The increase in strength produced by 5 per cent Cal in concrete mixtures at the 2-day period ranged from 52 per cent to 135 per cent, and the

strength of the treated concrete at this 2-day period equaled that of the untreated at from 3 to 4½ days. This represents a saving, on an average, of half the time in operations dependent on the strength of the concrete at early periods. The effect of the air storage in the concrete tests was lessened in degree, owing to the high relative humidity which existed throughout the storage period.

This increase in strength resulting from an addition of 5 per cent Cal does not represent the maximum which can be obtained except in very rich mixes. As much as 15 per cent Cal was used in mortar tests, giving an increase of 220 per cent at the 2-day period.

The general effect of Cal on Portland cement is the same as might be expected from equivalent amounts of hydrated lime and calcium chloride, and the 3-year tests by the Bureau of Standards on concrete gaged with a solution of calcium chloride are sufficient grounds for the belief that Cal will not in any way affect the ultimate strength and integrity of Portland cement concrete.

Advantages of Bituminous Concrete Foundations

Summed up under ten heads by Hugh W. Skidmore, of Chicago Paving Laboratory.

A few weeks ago, Hugh W. Skidmore, of the Chicago Paving Laboratory, read a paper before the Illinois Society of Engineers in which he advocated bituminous foundations for pavements. He stated that European engineers "maintain an extremely sceptical attitude toward rigid pavements." He briefly traced the history of bituminous foundations from the bituminous base pavements in Washington, D. C., to the present extensive use in California. He stated that a cement concrete base generally retained a film of moisture at the contact plane between it and a bituminous wearing surface, which not only tends to disintegrate the bituminous material, but also acts as a lubricant which is one of the causes of the pushing or rolling of an asphalt surface on a concrete base.

He said that while "reasonably good drainage must be provided if real success is to be obtained from the use of bituminous mixtures for foundation purposes," the same is true of other types of foundations as well.

He cited several contractors as claiming that the use of a bituminous base instead of concrete would save from 35 cents to a dollar or more per square yard, Owensboro, Ky., having saved more than $1 on the basis of 1917 prices. He summed up the advantages of bituminous concrete under ten heads, as follows:

(1) Provides homogeneity of mass and positive bond between foundation and wearing surface when bituminous top courses are employed.

(2) Provides uniform contact with the subgrade, thus insuring the benefit structurally of all of the beam strength possessed by the foundation slab and by the same token, makes certain uniform distribution of load to the subgrade.

(3) Because of the inherent flexibility of the material, the foundation slab will at no time be called upon to act as a rigid [illegible], therefore the possibility of the foundation rupturing, as is frequently the case with Portland cement-concrete, will be reduced to a minimum.

(4) Provides freedom from cracks and upheavals.

(5) Insures against the presence of moisture in the foundation structure, thus prolonging the life of the pavement.

(6) May be easily repaired at minimum cost; the surface patch method being applicable except in the case of very serious defects.

(7) Provides decided economies in construction as it disposes with the equipment and organization necessary to lay cement-concrete, thus affording the contractor the advantage of exclusive use of that portion of his ordinary equipment and labor organization which in actual operation has heretofore proven to be the most economical, and thereby profitable.

(8) Does away with the long period of time required for curing of the foundation, thus permitting the opening of completed work to traffic immediately and providing a rapidity of turnover to the contractor not possible in the case of rigid foundations.

(9) Permits the use of the same materials, except cement, as are employed in cement-concrete work.

(10) Under similar conditions, using the same aggregate materials bituminous concrete of equal thickness will be found to be cheaper than cement-concrete at present prices.

New York City Transit

Rapid growth of traffic demands radical changes and great increase of passenger transportation facilities. $550,000,000 expenditures estimated for next 25 years.

The annual report just submitted by Transit Construction Commissioner John H. Delaney to the legislature of the state of New York deals with the passenger transportation lines in New York City, of which there have been opened in 1920 nine different lines and extensions that have cost, in the aggregate, $67,150,000. During the year 41 contracts have been accepted as completed, 4 defaulted contracts have been relet, and 24 new contracts have been awarded.

During the year ending June 30 the total number of passengers carried by the rapid transit and surface railroads was 2,364,775,067, showing an increase of 284,832,063 over the passengers in the

preceding year. The report says: With an annual increase in traffic exceeding 10 per cent it is obvious that provision must be made without delay for extension of local transit facilities for all sections of the city. When the dual contracts were signed in 1913 the rapid transit lines carried 810,000,000 passengers for the twelve months immediately preceding the adoption of the new program. There has been an increase of approximately 615,000,000 passengers, or 76 per cent, in the intervening seven years, and the new trunk lines are already showing congestion.

Intensive study has been given to the rapid transit needs of the future and a report made on a comprehensive plan intended to meet the requirements of the various boroughs of the city during the next twenty-five years. The plan was so laid out as to encourage municipal growth in every direction and to prevent abnormal and congested conditions in certain sections and strangulation of growth in other areas. As laid down it is intended that the transit plan and the general city plan for new thoroughfares and highway improvement shall be co-ordinated in order that the best results may accrue to the general public. The growth of traffic per annum has been constantly in excess of the annual per capita growth of the city.

The enlarged system as laid out to care for the city's needs during the next twenty-five years would provide for an annual traffic of 5,000,000,000 passengers. Projected lines and extensions to the existing lines wherever they may originate in outlying boroughs are planned to enter and traverse the heart of the city which, from the transit viewpoint, is the area in Manhattan south of Central Park between Second and Tenth avenues.

The new transit plan takes into consideration the fact that vehicular and pedestrian traffic in the city streets is increasing to such an extent that it will soon be regarded as inadvisable to continue surface car operation either on the main arteries of travel or on the main cross-streets of Manhattan Borough, and that surface passenger transportation must be by subway travel with crosstown "tie lines" operated on a moving platform device, shuttle cars or by omnibuses. Because of the fact that the congested section of Manhattan has but 11 north and south through traffic arteries to serve more than 150 cross streets, it will be necessary to resort to "double deck" subway trunk lines in the central traffic arteries of the city that remain available for transit lines.

No close estimate of the cost of construction of the enlarged transit system is possible at present and it is not intended that the comprehensive scheme as laid out in its entirety will be undertaken at once but that it should be proceeded with methodically and continually. At pre-war prices it is estimated that the lines contemplated in the suggested program for the next twenty-five years would cost approximately $175,000,000 for construction. At present prices, however, this cost would amount to close to $350,000,000, exclusive of equipment, interest during construction, engineering and superintendence. For proper facilities and equipment an additional $200,000,000 would probably be required at present price level.

Pavements Laid During 1920—A Correction

In the tabulated data given under this heading in last week's issue there were a number of errors made by the printer in spite of repeated attempts at correction made by the editor. We greatly regret these, and give below the corrections of the several errors, which seems to be the best we can do to remedy the mistakes. We hope that subscribers will make these corrections in their copies in order that future reference to the tables may not yield incorrect information.

In the table at the top of page 266, under "Asphalt Concrete," the 7,373 is lineal feet and not square yards; and the 0.44 applies to Toronto and not to Walkerville. The quantities under "Bitoslag" should all be under "Warrenite-Bitulithic," and the 12,377 applies to Brampton and not to Port Angeles. The 30,050 is Bitoslag.

On pages 267 and 268 the names at the tops of the columns should be those appearing in the first part of this table, on the lower half of page 266, that is, should be "Amiesite" instead of "Sheet Asphalt," "Granite or other stone block" instead of "Asphalt Concrete," etc.

On page 267, fifth column, 19,263 applies to Irvington and not to Bridgeton, and 2,400 to Millville and not to Irvington. Sixth column, Sioux Falls, 2.70 should be 2,700. Seventh column, 71,021 applies to Paterson and not to Roosevelt. Eighth column, ½ applies to Millville and not to Paterson. Ninth column, Columbus, Kan., insert ¼; Irvington, N. J., insert 32,437§; the 20,000 applies to Roosevelt and not to Roselle Park; Media, Pa., insert 3,000b; the ¾ applies to Bonham and not to Childress; the 4 applies to Eastland and not to Cisco.

On page 268, second column, Toronto, Ont., insert 0.4. Third column, Moundsville, W. Va., insert 2,100. Fifth column, 5,880 applies to Bennington and not to Galveston; the 16,000 applies to West Allis and not to Port Angeles, and the 1.76 to Toronto and not to West Allis. Sixth column, 3,467 applies to Auburn and not to Roanoke; the 3 for Moundsville should be omitted; the 1¼ should be 1½. Seventh column, 1.1 applies to Roanoke but to neither Rutland (misspelled Ruthland) nor Auburn. Last column, the 1,442 applies to Auburn and not to Roanoke; 1¼to Ashland and not the Clarksburg; 400 to Lake Geneva and not to Menasha (misspelled Menosha).

Good roads advocates of Alabama are proposing resubmitting to popular vote the proposition to bond the state for $25,000,000, the previous election having been declared illegal, as told in our March 19 issue. A poll of the legislature indicates that the vote would again have a large majority in its favor.

PUBLIC WORKS

Published Weekly
by
Municipal Journal and Engineer, Inc.
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates

United States and Possessions, Mexico and Cuba....$3.00 per year
All other countries .....$4.00 per year

Change of Address

Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

CONTENTS

COSTLY RAILROAD RE-LOCATION—Illustrated 273
SAND FILTERS FOR SMALL SEWAGE PLANTS —By W. A. Hardenbergh 275
WATER RATES FOR SMALL MINNESOTA VILLAGES 276
Duluth Water and Light Notes 276
Repairing Water Works Steam Pump—Illustrated.... 277
Belt Conveyors for Aggregate 277
EFFECT OF CAL IN PORTLAND CEMENT..... 278
ADVANTAGES OF BITUMINOUS CONCRETE FOUNDATIONS 279
NEW YORK CITY TRANSIT 279
Pavements Laid During 1920—A Correction 280
EDITORIAL NOTES 281
Construction Budgets—Disposal of Municipal Refuse
Paving in American Cities 282
CITY PAVEMENTS TO BE LAID IN 1921..... 283
HOW TO CONCRETE A 2 IN 1 SLOPE WITH A SLAB LINING HAVING FEW JOINTS 287
Blasting Down Trees 288
RECENT LEGAL DECISIONS 289

Construction Budgets

Movement for the control of Federal expenditure in accordance with a general budget is nowhere more important than in relation to construction work, where the principle applies equally to state, county and municipal undertaking. The absence of the budget tends to make the work uncertain, defective and too costly, affording vast opportunity for extravagance, dishonesty, political manipulation and embarrassment to efficient and conscientious people associated with its planning and execution.

No successful private or corporation business is carried on without a very careful preliminary survey, analysis, estimate of cost and appropriation of a reliable budget, which is conspicuously absent in the United States Government and in that of many subordinate departments of this country. While it is important in every department, it is in none of them more vital than in construction of public work where forethought, uniformity, safe practice and ample resources ably conserved are indispensible to success and efficiency.

A budget and a reorganization and co-ordination of the different construction branches throughout the country could diminish waste and provide for adequate preliminary surveys and analyses, thus insuring suitable design. It would secure adequate resources for approved operations, thus saving enormous waste and expense due to delay, interruption and ill-advised operation. It would promote great savings by the adoption of standards, concentration of direction and skill, and the elimination of duplication of labor and supplies. It would promote the greatest efficiency, economy and expedition of work and the development of permanent technical and construction forces of the highest grade.

The establishment of the budget system was strongly urged by Judge Warwick, Comptroller of the Treasury of the United States in a recent paper before the Associated General Contractors of America. His view should be indorsed and efficiently supported by all contractors, engineers and officials who are interested in public construction and its welfare.

Disposal of Municipal Refuse

No city is providing for the convenience and health of its citizens to the extent which they have a right to expect if it is not collecting and disposing of all rubbish and ashes as well as garbage. In performing this service, the health and convenience of all the citizens should be the first consideration, but of course a limit will be placed by the cost of improved service.

In connection with cost, many alluring statements have been made concerning profits to be derived from reduction of garbage or feeding it to pigs; from creating steam by burning rubbish or from the sale of materials salvaged from it. Any of these claims should be examined carefully by an expert before acceptance for any given case.

In the first place, we believe no city has ever recovered, by any municipal treatment of waste, a net profit covering cost of collection as well as of disposal; and very few can show a net profit from disposal alone; in fact, we know of none that can do so if sufficient allowance be made for interest and depreciation of plant. It must, of course, be recognized that in any event some disposal must be made of the refuse, and if the net cost is less for any given method than for others equally acceptable otherwise then that one is preferable.

But plants for incinerating rubbish have been provided with steam-raising adjuncts at such great additional expense, and so little use actually made of the steam, that the value of such use seldom covers the interest alone on the adjunct, to say nothing of repairs and depreciation. Also,

rubbish is sometimes hauled long distances to a special plant and subjected to salvaging operations at considerable cost, when the returns from sale of the salvaged material will not cover the cost of such operations and of the additional haul which could be avoided by use of local incinerators or possibly of several dumps.

Again, utilization of garbage by pigs or reduction plants leaves rubbish and ashes unprovided for, and as stated above, the city should collect and dispose of these also. The collection, transportation and disposal of all three kinds of refuse is one composite and complex problem, and solving one of the elements of it without consideration of the others is the height of unwisdom. Both forms of utilization require expert knowledge and constant, conscientious vigilance —and cities seem to find it difficult to obtain and retain either of these. Even private pig raising companies fail to make profits—three have recently thrown up their contracts with cities.

With very few exceptions the wisest plan for any city is to waste no time figuring on how to make a profit from its refuse, but to concentrate on collecting and disposing of it with a minimum of objectionable features and of cost. While at present some large cities may find other plans preferable, and for the small ones the smallest incinerator unit may be too large, and the smallest disposal unit—the pig—may be advisable, or burial outside the occupied area; yet the most promising method of disposing of rubbish and garbage, for all but the smallest and largest cities, seems to be a good incinerator, with no expensive boiler attachment for raising steam, but of a design and construction that will burn all the refuse without odor or purchased full and at little cost for operation, upkeep and repairs.

Paving in American Cities

A tabulated statement of paving conditions in 195 American cities (including 84 of the 227 having more than 30,000 population), showing conditions at the beginning of the year 1920 has just been published by the Asphalt Association. The figures show for each city the total amount of pavement and the number of square yards of gravel, water-bound macadam (each of these including those with surface treatment), bituminous macadam, asphaltic concrete, sheet asphalt, brick, Portland cement concrete, asphalt block, wood block, stone block, other asphaltic pavements, and other non-asphaltic pavements.

In amount of pavement, New York leads with 41,375,576 square yards, Chicago is next with 38,430,330, Philadelphia is third with 22,609,962, Los Angeles is fourth with 21,515,424, Boston is fifth with 11,158,919, Pittsburgh is sixth with 10,403,200, and the only other city in the list with more than 10,000,000 yards is Cincinnati with 10,169,709, this including alleys.

The total amount in all the cities listed is 364,901,611. Of this, 28.97 per cent is sheet asphalt, 16 per cent is water-bound macadam, 13.96 per cent is brick, 10.23 per cent is gravel, 10.18 per cent is stone block, 7.25 per cent is asphaltic concrete, 3.91 per cent is bituminous macadam, 2.95 per cent is Portland cement concrete, 2.83 per cent is wood block, 1.75 per cent is asphaltic block, 1.37 per cent is other non-asphaltic types and 0.63 per cent is other asphaltic types.

The statement also gives the oldest pavement of each type in each of 25 leading cities. These oldest pavements are classified by types and arranges by decades. Only one pavement in service in any of the cities was laid prior to 1880, this being a sheet asphalt laid in Washington, D. C., in 1873. In the decade 1880 to 1889, 6 cities laid sheet asphalt pavements that are still in service, 7 cities laid granite block, 2 laid brick and 1 wood block. In the decade 1890 to 1899, 13 cities laid brick, 9 laid sheet asphalt, 3 laid granite block, 3 macadam and 1 wood block. In the decade 1900 to 1909, 6 laid asphalt concrete, 5 laid macadam and granite, 5 sheet asphalt, 5 Portland cement concrete and 5 wood block, 4 laid bituminous macadam, 3 granite block and 2 brick. In the decade 1910 to 1919, 13 laid asphaltic concrete that is still in service, 11 Portland cement concrete, 8 laid wood block, 5 bituminous macadam, 2 sheet asphalt, 1 brick and 1 granite block.

In each case the condition of each oldest pavement was indicated as excellent, good, fair, bad and poor. The only excellent pavements were the asphaltic concrete of Wilmington (1911) and Lincoln, Neb. (1912), the sheet asphalt of Wilmington (1905) and the wood block of St. Paul (1912). Combining these reported as good or excellent, we find asphaltic concrete leading with 94 per cent, sheet asphalt next with 82 per cent, then Portland cement concrete, 75 per cent; granite block, 64 per cent; wood block, 57 per cent; bituminous macadam, 33 per cent; brick, 27 per cent; and macadam and gravel, 14 per cent. As this includes pavements of all ages from 47 years to 1 year old, it is distinctly to the advantage of the newer types of pavement such as Portland cement concrete and asphalt concrete. There is, therefore, given the average age of all of the pavements listed under each classification. These averages are 12¾ years for granite block, 11½ years for brick and for sheet asphalt, 9 years for macadam and gravel, 4½ years for bituminous macadam and 4 years for asphaltic concrete and Portland cement concrete. We have endeavored to give a composite rating combining these two features (without claiming that it is a technically exact or correct method) by taking for each class of pavement the product of the average age and the percentage reporting good or excellent. These products so arrived at compare as follows: Sheet asphalt, 943; granite block, 821; asphaltic concrete, 376; wood blocks, 328; brick, 310; Portland cement concrete, 300; bituminous macadam, 148; macadam and gravel, 126.

The above comparison included only the oldest pavement of each type for each city and of course gives no indication of the condition of any other pavements in the several cities.

City Pavements to Be Laid in 1921

Information furnished by six hundred city officials during the past two months giving amounts of the different kinds of pavement that they were expecting to lay, together with the name and title of the official. Quantities are in miles or square yards (the size of the number indicates which) unless otherwise stated.

LIST OF ABBREVIATIONS

TITLES OF OFFICIALS IN CHARGE

B. E.—Borough Engineer
B. Sp.—Borough Superintendent
C. Ck.—City Clerk
C. E.—City Engineer
C. M.—City Manager
C. P. W.—Commissioner of Public Works
Ch. E.—Chief Engineer
Civ. E.—Civil Engineer
Co. E.—County Engineer
Co. Surv.—County Surveyor
Con. E.—Consulting Engineer
D. E.—District Engineer
Dir. P. W.—Director of Public Works
Dv. E.—Division Engineer
H. E.—Highway Engineer
M. P. U.—Manager of Public Utilities
S. P.—Superintendent of Paving Division
S. S.—Street Superintendent
S. St. Dp.—Superintendent of Street Department
S. & E.—Superintendent and Engineer
Sp. H.—Superintendent of Highways
Sp. P. W.—Superintendent of Public Works
St. C.—Street Commissioner
T. E.—Town Engineer
V. E.—Village Engineer

KINDS OF PAVEMENT

A—Amiesite
Ac—Asphalt Concrete
Am—Asphalt Macadam
B—Brick or Clay Block
Bg—Bitoslag
C—Concrete, not Reinforced
Cr—Concrete, Reinforced
Cs—Cement Sidewalks
G—Gravel
M—Plain Macadam
R—Rock Asphalt
S—Granite or other Stone Block
Sa—Sheet Asphalt
Tc—Tar Concrete
Tm—Tar Macadam
W—Willite
Wb—Warrenite-Bitulithic
Wd—Creosoted Wood Block

ALABAMA:
Bessemer, Gano W. Robertson, C. E., 59,000 Wb.
Florence, L. E. Goddard, C. E., 15,000 Wb.
Gadsden, Ernest Smith, C. E., 40,000 Ac, 11,000 B, 4,000 Cs.
Montgomery, H. A. Washington, C. E., 40,500 C, 7,000 Wb, 7,050 G.

ARIZONA:
Prescott, J. William Waara, C. E., 43,900 Wb, 8,250 C.
Winslow, J. W. McCreary, C. E., 12,000 Wb.

ARKANSAS:
Fort Smith, W. H. Evans, C. E., 40 Am or C.
Little Rock, Jas. H. Rice, C. E., 2 Ac, 1 C, 3 Cs.
Paragould, W. R. Heagles, W. R. Heagles & Sons, 20,500 Ac, 2 G.
Pine Bluff, J. H. Guest, C. E., 7,500 B, 27,500 C, 15,000 G, 2 Cs.

CALIFORNIA:
Bakersfield, R. H. Hubbard, C. E., 13,711 W, 9,200 C, 29,262 Cs.
Calexico, 16 Cs.
Chico, Frank S. Robinson, C. E., 60,000 Ac, 100,000 Wb.
El Centro, Philip W. Knights, C. E., 100,000 W, 5,000 lin. ft. Cs.
Los Angeles, John A. Griffin, C. E., 272,110 Sa, 11,020 Ac, 103,422 Wb, 203,550 C, 1,771,442 G, 2,016,904 sq. ft. Cs.
Monrovia, H. S. Gierlick, C. E., 4 C.
Napa, H. A. Harrold, C. E., 5,000 Am, 6,000 C, 2,000 Cs.
Ontario, F. E. Alford, C. M., ¾ C, 10 M, 2 G, 5 Cs.
Oroville, S. H. Norris, C. E., 31,400 Wb.
Palo Alto, J. F. Byxbee, Jr., 60,000 Ac, 65,000 C, 2,000 Cs.
Pasadena, E. P. Dervey, C. E., 72,000 Sa, 93,000 Am, 48,000 C.
San Francisco, James M. Owens, H. E., 50,000 Sa, 200,000 Ac, 1,000 S, 13,000 B, 25,000 C.
San Luis Obispo, Warren B. Burch, C. E., 25,000 C, 40,000 G, 5,000 Cs.
Vallejo, W. S. Kilkenny, C. E., 3,400 Ac, 2,000 C, 50,000 sq. ft. Cs.
Venice, W. F. Crawford, C. E., 1 Ac, 4 W, ¾ C.
Ventura, H. B. Ward, C. E., 48,000 Wb.

COLORADO:
Boulder, Jay Randolph, C. E., 10 G, 53,000 Sa or Ac or Tc.
Denver, C. H. Craney, S. P. D., 25,000 Sa, 150,000 Ac, 25,000 W, 50,000 C.
Fort Collins, W. B. Cheek, C. E., 78,845 Cr, 2,089 C, 6,000 G, 18,400 Cs.
La Junta, F. T. Lewis, C. E., 300,000 C.
Longmont, Edwin S. Bice, C. E., 32,000 C.

CONNECTICUT:
Bristol, 4,000 cu. yds. C, 20,000 sq. ft. Cs.
Derby, V. B. Clarke, C. E., $30,000 G.
Hartford, Leon F. Peck, S. St. Dp., 61,250 Sa, 19,920 Ac, 17,000 C, 35,000 M 5 Cs.
Manchester, J. Frank Brown, S. and E., 3 Cs.
Milford, V. B. Clarke, T. E., $10,000 Sa, $100,000 Am, 30,000 A.
New Canaan, Walter K. Goodhue, C. E., 5,000 lin. ft.
Norwich, Chandler Palmer, C. E., 10,000 C.
Stafford Springs, J. M. Leach. St. C., 7,000 Tc.
Stamford, Paul Nash, C. E., 10,000 Tm, 10,000 sq. ft. Cs.
Torrington, B. O., ½ Tm.
Wallingford, Wm. A. Mackenzie, B. E., 2,000 Ac.

DELAWARE:
Lewes, Chas. H. Lynch, E., 8,000 sq. ft. Cs.

DISTRICT OF COLUMBIA:
Washington, 64,000 Sa, 16,469 C, 1,000 M, 40,000 Cs.

FLORIDA:
Orlando, G. R. Ramsen, C. E., 100,000 B.
Sanford, Fred T. Williams, E. C., 16,000 Am, 30,000 sq. ft. Cs.

GEORGIA:
Albany, C. Q. Wright, C. E., 8,000 Ac.
East Point, C. E. Hutchinson, 5 Cs.

IDAHO:
Boise, C. C. Stevenson, C. E., 3 Cs.
Coeur D'Alene, W. T. Bassett, D. E., 13 C, 51 M.
Nampa, Louis C. Kelsey, Con. E., 55,000 Wb, 75,000 sq. ft. Cs.

ILLINOIS:
Benton, C. B. Mantz, C. E., 21,723 C, 18,335 novaculite.
Cairo, George F. Dewey, C. E., 2,400 B, 26,000 M.
Canton, E. F. Motsinger, C. E., 5,900 B.
Centralia, L. W. Lemon, C. E., 30,000 C, 20 Cs.
Champaign, F. C. Lohmann, C. E., 8,000 C, 10 Cs.
Chicago Heights, M. H. McCoy, C. E., 3,600 C.
Cicero, John Blazek, T. E., 5 Sa.
Danville, Harlan H. Edwards, C. E., 3,400 lin. ft. B, 2½ Cs.
Decatur, Preston T. Hicks, Sp. H., 2,950 lin. ft., 4 Cs.
Galesburg, F. M. Connolly, C. E., 21,015 B.
Geneva, Wells Engr. Co., 4,000 B, 21,000 C.

Joliet, A. S. Calkins, C. E., 30,000 Ac, 5,000 B, 40,000 sq. ft.
Kankakee, Robt. D. Gregg, C. E., 10,000 B.
La Grange, Edwin Hancock, E., 10,000 Sa.
Marion, P. B. Wilson, C. E., 12,000 C, 10,000 G, 350,000 sq. ft. Cs.
Moline, A. D. Payton, C. E., 70,000 Ac, 40,000 B, 7,700 Cr, 4,340 C, 100,000 sq. ft. Cs.
Mt. Carroll, S. C. Campbell, C. E., 6,000 B.
Murphysboro, R. A. Rollo, C. E., 60,000 B, 30,000 sq. ft. Cs.
Oak Park, Dudley C. Meyers, E., 35,000 Sa, 2,000 Ac, 6,000 C, 40,500 sq. ft. Cs.
Ottawa, George L. Farnsworth, C. E., 80,000 Ac, 3,000 B.
Pekin, Ben F. Smith, C. E., 13,200 B.
Spring Valley, P. M. Mahoney, C. Clk., 1 G, 2 Cs.
Waukegan, M. J. Douthitt, C. E., 3,035 C, 1,700 ft. Cs.
Wheaton, L. J. Ruddock, C. E., 6,600 C.
Winnetka, Frank S. Windes, Windes & Marsh, Engrs., 6,000 to 10,000 lin. ft. Cs.
Zion, Jas. J. Craig, ½ Cr, 1 C.

INDIANA:
Covington, Colonel W. Santman, C. E., ¾ Cr.
Elkhart, Harmon J. Weaver, C. E., 13,800 Sa, 10,050 B, 3,000 C.
Elwood, John D. Seright, C. E., 1,160 Cs.
Evansville, Jas. D. Saunders, C. E., 100,000 Sa.
Franklin, Thos. D. House, C. E., 10,000 Ac.
Fort Wayne, Frank M. Randall, C. E., 80,000 Sa, 60,000 Ac, 50,000 Cs.
Gary, W. P. Cottingham, C. E., 108,000 Sa, 27,000 Ac, 25,000 Am, 30,000 Tm, 35,000, Cr, 8,000 C, 6,000 Cs.
Greenfield, Charles Boone, C. E., 6 G.
Hartford City, Wm. Harley, C. E., 15,000 B, 7,000 Cr.
Jennings, Charles W. Miles, Co. Surv., 28,580 M, 5,317 G.
Kokomo, C. M. Ray, C. E., 6,338 Sa, 13,673 Cr, 2,656 cu. yds. G, 35,505 sq. ft. Cs.
Lafayette, H. F. Kessener, C. E., 20,000 B, 8,400 G, 5,600 Cs.
La Porte, Burtis P. Thomas, C. E., 30,000 Sa.
New Albany, Saml. T. J. Kann, C. E., 20,000 Cr, 10,000 C, 1,500 M, 25,000 Cs.
Peru, John Horan, C. E., 15,106 Sa, 15,500 B, 8,000 G.
South Bend, F. J. Anderson, C. E., 9,240 Sa, 29,800 Ac, 4,828 M.
Terre Haute, R. A. Koerner, C. E., 4,500 Wb, 20,300 C, 3 G, 3 Cs.
Wabash, H. D. Hartman, C. E., 18,000 Sa, 9,000 M, ¾ Cs.

IOWA:
Atlantic, T. E. Bichols, C. Clk., 6,000 C.
Boone, C. L. Elkhart, C. E., 10 Cs.
Charles City, James S. Dawson, E., 20,000 Ac, 15,000 Cr, 15,000 sq. ft. Cs.
Cherokee, Wm. Shardlow, C. Clk., 5,629 C.
Davenport, Roscoe K. Earle, C. E., 50,000 Sa, 50,000 Ac, 15,000 tarvia, 10,000 C.
Denison, Frank Woolston, C. E., 80 blocks.
Emmetsburg, T. R. Nartin, 7,500 Cs.
Fort Dodge, C. H. Reynolds, C. E., 45,000 Ac, 1,500 C.
Garner, J. G. Thorne, Con. E., Clinton, 50.000 Cr.
Kingsley, T. H. Johnson, Con. E., Sioux City, 65,000 Cr.
Mason City, Fred P. Wilson, C. E., 40,000 Cr.
New Hampton, W. R. Garland, C. E., 2 As.
Oskaloosa, H. C. Hawkins, C. E., 21,000 Ac.

KANSAS:
Arkansas City, C. W. Lusk, C. E., 62,000 B.
Columbus, C. M. Cooper, C. E., ½ G. ½ Cs.
Dodge City, Fred. Kirkpatrick, C. E., 25,000 B.
McPherson, H. A. Rowland, C. E., 3½ Sa.
Manhattan, Arthur J. Rhodes, C. E., 35,000 Ac, 15,000 B.
Ottawa, B. W. Harris, Comr., 2 blocks B.
Salina, P. G. Wakenhut, C. E., 20,000 Ac or B.
Topeka, W. E. Baldry C. E., 10,000 Ac, 1,800 B, 18,000 C, 6,000 sq. ft. Cs.
Winfield, T. P. Alford, C. E., 1 Sa, 2 B, 1,500 ft. M, 1 Cs.

KENTUCKY:
Ashland, Thos. Boggess, C. E., 19,700 Tm, 28,955 B.
Madisonville, George M. Flanagan, C. E., 17,000 R, 7.8 Cs.
Maysville, W. L. Glazier, C. E., 2,500 B, 5,000 Cs.
Middlesboro, J. C. Richardson, C. E., 44,250 R.
Newport, Jos. Hermann, C. E., 10,000 Cr, 3,000 M.

LOUISIANA:
Crowley, Merrill Bernard, C. E., 12,000, sq. ft. Cr, 2 G.
Kentwood, T. G. Wirnock, 2 G, 6 Cs.
Lafayette, L. J. Virgues. 20,000 B or Cr, 15 G.
South Highlands, A. A. Lyons, C. E., 45,000 Ac, 100,000 sq. ft. Cs.

MAINE:
Lewiston, John A. Jones, C. E., 21,000 Tm.
Portland, H. C. Robinson, Dv. E., 5,000 Ac, 5,556 S, 4,600 B, 1,911 C, 2,500 Cs.
S. Paris, Charles W. Bowker, Co. Comr., ½ C.
Westbrook, Alex. Jones, C. E., 4,000 Am, 525 B.

MARYLAND:
Frederick, Emory C. Crum, C. E., 500 Ac, 16,000 Am, 3,500 B.
Hagerstown, J. B. Ferguson, C. E., 15,000 Tm, 3,000 S, 2,000 Cs.

MASSACHUSETTS:
Andover, F. C. Cole, Sp. H., 1½ tarvia.
Attleboro, H. J. Goodale, Sp. Pub. Wks., 2 Ac, 600 Cs.
Braintree, Hartley L. White, ½ Ac.
Easthampton, M. J. O'Neill, T. E., 33,000 Am, ½ G, 1,800 Cs.
Greenfield, E. M. Schneck, S. S. and T. E., 5,000 Am, 2,600 Cr, 3,000 M, 15,000 G, 7,500 ft. Cs.
Holyoke, T. J. MacCarthy, C. E., 2 C.
Lawrence, R. W. Priestman, C. E., 60,000 Am, 13,800 S.
Millbury, W. B. Haine, 1½ C.
Newton, George E. Stuary, St. C., 13,400 Am, 10,500 Tm, 26,000 G, 26,000 sq. ft. Cs.
North Adams, W. I. Baucus, C. E., 5,000 C.
Orange, G. M. Underwood, S. S., 1 G.
Pittsfield, A. B. Farnham, E., 7,800 B, 20,000 C, 5,000 Cs.
Wakefield, W. R. Tompson, S. S., 7,500 Am, 11,000 G, 1,400 Cs.
Waltham, G. C. Brehm, C. E., 75,000 Am, 10,000 M.
Watertown, Forrest J. Maynard, T. E., 2,500 Sa, 13,500 Am, 10,883 C, 50,000 Cs.

MICHIGAN:
Alma, W. E. Reynolds, C. M., 2 Cr, 20,000 lin. ft. Cs.
Ann Arbor, Geo. H. Sandenburgh, C. E., 50,000 G.
Battle Creek, E. U. Haut, C. E., 50,000 Sa.
Bay City, H. C. Thompson, C. E., 2,000 Ac, 8,000 lin. ft. Cs.
Dowagiac, Clint Voorhees, Sp. P. W., 1,000 C, 2 G, 25,000 sq. ft. Cs.
Escanaba, W. J. Hudson, C. E., 20,320 Tm, 13,360 C.
Flint, 200,000 Sa, 400,000 Cs.
Hastings, Bert Sparks, C. E., 1 C, 1 Cs.
Holland, Jacob Zuidema, C. E., 20,000 Cs, 10,000-20,000 W or C.
Ironwood, Jas. Goudie, C. E., 10,000 Tm, 20,000 Cs.
Ishpeming, J. E. Hayden, C. E., 6,000 Am.
Munising, Albert Oas, C. Clk., 1,000 Tm.
Jackson, W. B. Hodges, C. E., 175,000 Sa.
Lansing, S. E. Eckert, C. E., 100,000 Sa, 4,000 B, 4,000 C, 3 Cs.
Muskegon, Ross J. Buck, Dir. P. W., 20,000 Sa.
Saginaw, H. H. Eymer, C. E., 30,000 Sa.
Sturgis, Geo. A. Eagleton, C. E., 12,210 B, 33,000 C.
Three Rivers, O. O. Johnson, C. M., 4,000 ft. C, 1 G.
Ypsilanti, T. Fred Older, M. P. U., 5,000 C.

MINNESOTA:
Cloquet, Archie Campbell, St. C., 20,000 sq. ft. Cs.
Fairmont, Thos. H. Curtis, C. E., 8,000 Wb, 8,000 Cr.
Faribault, F. W. McKelly, C. E., 4,300 Cr, 3-5 M.
Hibbing, E. J. Hawley, C. E., 22,100 Wb.
Luverne, T. H. Johnson, Con. W., Sioux City, Ia., 145,000 Cr.
Minneapolis, F. W. Cappelen, C. E., 150,000 Ac, 18,000 S, 40,000 B, 71,000 Wd, 12,000 C, 40 Cs.
St. Cloud, M. B. Lang, C. E., 30,000 Wb, 15,000 Cs.
St. Paul, Ch. E., 150,000 Sa, 75,000 Ac, 20,000 Wd, 8,000 C, 75,000 Cs.
St. Peter, H. W. Daniels, C. E., 5.8 tarvia and oil.
Two Harbors, P. A. Cullen, C. Clk., 2,280 ft. Cr.
Virginia, E. F. Johnson, C. E., 26,000 Cr, 36,000 sq. ft. Cs.
Winona, E. E. Chadwick, C. E., 7,400 Tc, 50,000 sq. ft. Cs.

MISSISSIPPI:
Clarksdale, W. S. Bobo, C. E., 10,000 Ac, 38,000 G, 1,500 Cs.
Greenwood, F. T. Walker, C. E., 20,000 Ac.
Tupelo, N. B. Buchanan, C. E., 15 Cr. and C.

MISSOURI:
Batesville, W. R. Heagles, W. R. Heagles & Sons, 106,000 Ac.
Bethany, John J. Werninger, 3,000 C.

Booneville, T. T. Hale, C. E., 1¼ Am, 2,000 ft. B, 1,200 ft. C.
Brookfield, Lee Fletcher, C. E., 5,000 Tm.
Carthage, Frank B. Newton, C. E., 3 C.
Fredericktown, C. T. McCormick, Co. E., 5 G.
Fulton, F. E. Baker, C. E., 14,000 M, 2,000 G, 8,000 sq. ft. Cs.
Jefferson City, Linn F. Brown, C. E., 120,000 Am, 10,000 Cs.
Malden, W. R. Heagles, W. R. Heagles & Sons, 45,000 tarvia or Ac.
Poplar Bluff, E. C. Thomas, E., 20,000 C, 10,000 Cs.
St. Charles, Carr Edwards, C. E., 33,000 Tm, 20,000 B, 1,000 G, 3,000 Cs.
St. Louis, W. U. Horner, Ch. E., Sewers and Paving, 180,000 Sa, 136,757 Wb, 18,260 Am, 18,260 Tm, 7,985 S, 71,334 B, 8,470 Wd, 43,445 C, 30,000 sq. ft. Cs.
Sedalia, F. T. Leaming, C. E., 10 Am. 10,000 B, 10,000 C, 3 Cs.
University City, Walter A. Heimbuecher, C. E., 8,500 Cr, 27,353 C.

MONTANA:
Billings, E. M. Sneckenberger, C. E., 19,900 C.
Bozeman, C. C. Widener, Con. E., 23,000 Wb.
Great Falls, L. B. Evensen, C. E., 28,300 Wb, 19,000 Cr, 6,000 C, 35,000 sq. ft. Cs.
Havre, H. R. J. Meyer, C. E., 3 G, ½ Cs.
Lewiston, R. P. Longshore, C. E., 27,066 Cr.

NEBRASKA:
Fremont, L. M. Roessler, C. E., 1,500 B, 21,000 C.
Hastings, George B. Blautstone, C. E., 50,000 Sa, 10,000 B.
Homer, T. H. Johnson, Con. E., Sioux City, Ia., 15,000 C.
Lincoln, Geo. W. Bates, C. E. 20,000 Sa. 40,000 Ac, 20,000 B, 2,500 C, 200,000 Cs.
Nebraska City, C. A. Shannon, C. E., 40,000 B or Sa.
North Platte, C. J. McNamara, Civ. E., 70,000 covering Sa, Ac, Wb, B and Cr.
Omaha, H. E. Cotton, Asst. C. E., 50,000 Sa, 100,000 Ac, 50,000 B, 5,000 Cr, 20,000 C, 25,000 sq. ft. Cs.

NEVADA:
Reno, Harry Chism, C. E., 71,000 Ac, 2,700 C, 1 Cs.

NEW HAMPSHIRE:
Laconia, C. A. French, C. E., 10,000 Tm.

NEW JERSEY:
Bloomfield, Ernest Buechlin, T. E., 10,000 Sa, 10,000 Wb, 5,000 C, 1,000 M, 20,000 Topeka.
Bordentown, J. Horace Eaton, C. E., 882 Sa.
Bound Brook, H. M. Herbert, B. E., 9,000 Cr, 5,000 M.
Clifton, Russell S. Wise, C. E., 50,000 sq. ft. Cs.
Garfield, Anton L. Petterson, C. E., 83,508 Am, 70,766 sq. ft. Cs.
Highland Park, John T. Hopkins, B. E., 1 Cs.
Long Branch, J. W. Seaman, C. E., 25,000 Sa.
Millville, Newton B. Wade, C. E., 14,500 Cr, ½ G.
Newark, William A. Howell, E. in charge of Bureau of Paving, 40,000 Sa, 5,000 Wb, 45,000 S, 50,000 Cr, 6,000 Asphalt Block.
Orange, Kenneth Crane, Asst. E., 50,000 Wb, 13,000 Am, 8,800 Hasting Asphalt Block, 5,000 Cr, 1,475 Cs.
Plainfield, A. W. Vars, C. E., 7,500 Tc, 30,000 B, 20,000 M, 20,000 sq. ft. Cs.
Ridgefield Park, Rudolph Schweizer, Jr., V. E., 34,500 Tm, 18,250 A, 6,700 Cr.
Roosevelt, Fred F. Simons, B. E., 15,000 Cr, 50,000 sq. ft. Cs.
Roselle, J. L. Bauer, B. E., 10,000 Cr, 20,000 sq. ft. Cs.
Roselle Park, I. Wallace Higgins, B. E., 2,370 Tm, 38,-130 Cr.
Rutherford, Robt. M. Watson, B. E., ½ Am, 3 Tm, 1 Cs.
South Orange, Ira T. Redfern, E., 4,000 Cr, 6,000 Asphalt Block.
Westfield, Edward Masher, T. E., 17,000 C, 20,000 M.
West New York, Carl Guisback, T. E., 8,000 Wb, 1,200 S.

NEW YORK:
Albany, W. P. Graham, C. E., 10,000 Sa, 3,000 Ac, 35,000 S, 2,000 C.
Binghamton, W. Earl Weller, C. E., 5,800 Ac.
Buffalo, C. E. P. Babcock, 1st Asst. E., 295,000 Sa, 10,500 S, 6,000 B, 2,800 Wd, 150,000 sq. ft. Cs.
Corning, Wm. O. Drake, C. E., 19,890 B, 14,630 Cr.
Endicott, C. R. Hunt, V. E., 1½ Wb, 13,680 B.
Geneva, J. W. Brennan, C. E., 15,000 Sa, 15,000 Wb, 15,000 B, 15,000 Cr.
Glens Falls, Ernest L. H. Meyer, C. E., 1,400 B, 20,000 Cs.
Haverstraw, W. A. Welch, C. E., 8,000 Am, 500 Cs.
Herkimer, C. Leland Wood, C. E., 9,000 Cr, 4,000 G, 3,000 sq. ft. Cs.
Hudson Falls, P. C. Richards, V. E., 4,200 C, 10,000 sq. ft. Cs.
Jamestown, E. C. Dollard, C. E., 30,000 B.
Lackawanna, F. C. Strack, Jr., E., 1.3 Cr, 4.7 M, 2.5 Cs.
Little Falls, Silas S. Feeter, C. E., 13,000 Cr.
New York City, Brooklyn, H. H. Smith, Ch. E., 432,000 Sa, 7,000 Am, 250,000 Cs.
Manhattan, Queens, Fred H. Shepheard, Asst. E., 100,000 Sa, 300,000 Ac, 250,000 Am, 25,000 S, 15,000 Ed, 35,-000 M.
Niagara Falls, 13,378 C, 107,207 various.
N. Tonawanda, Carl L. Oelkers, C. E., 38,500 Wb, 200 Cr.
Ogdensburg, Geo. A. Tate, C. E., 10,000 Cr, 6,000 to 10,000 M.
Olean, E. E. Allen, C. E., 3.74 B, .23 Cr.
Oneonta, Frank M. Gurney, C. E., ½ G, 3,000 Cs.
Plattsburgh, N. J. Langlois, C. E., 6,000 Cs.
Port Chester, Chester A. Studwell, V. E., 1,800 S, 1,000 Cr, 5,400 C, 60,000 Cs, 35,000 Asphalt Block.
Poughkeepsie, Thos F. Lawlor, Sp. P. W., 6,300 Am, 25,600 Cr.
Salamanca, C. C. Cheney, C. E., 25,000 G, 30,000 Cs.
Schenectady, Geo. I. Howard, C. E., 33,500 Cr.
Watertown, P. B. Sutton, C. E., 5,300 C.
Watkins, Chas. E. Dennis, Sp. P. W., 1 G.

NORTH CAROLINA:
Asheville, B. M. Lee, C. E., 55,600 S, 10,135 C, 7,000 Cs.
Durham, H. W. Kueffuer, C. E., 15,000 Sa, 1,200 Durax, 500 B, 6,000 Cs.
Fayetteville, E. C. Derby, C. E., 10,000 Am, 10,000 Cs.
Greensboro, M. M. Boyles, C. P. W., 3 Wb, 2 C, 12 Cs.
Monroe, C. W. Lee, Supt. Water and Light, 1 Ac.
Statesville, R. L. Greenlee, C. E., 14,300 Sa, 7,200 Ac, 10,000 Cs.
Washington, P. C. Painter, C. E., 30,000 Sa, 65,000 B, 20,000 Cs.
Wilson, Gladding & Morrison, Con. E., 75,000 Wb.

NORTH DAKOTA:
Fargo, W. B. Stevenson, 20,000 Wb, 15,000 Cr.
Minot, E. J. Thomas, C. E., 10,000 Wb, ½ G.
Valley City, Jay W. Bliss, C. E., 17,000 G, 24,000 sq. ft. Cs.

OHIO:
Akron, E. A. Kemmler, H. E., 150,000 Sa, 10,000 Ac, 60,-000 B, 2,000 Cr, 120,000 Cs.
Alliance, H. E. Anderson, C. E., 7,000 Ac, 45,000 B, 6,000 Cs.
Bucyrus, F. L. Niederheiser, C. C. E., 10,000 sq. ft. Tm, 13,000 B.
Chillicothe, H. M. Redd, C. E., 11,800 Am.
Columbus, R. H. Simpson, Ch. E., 5.8 Sa, .8 S, .6 B, 1.8 C.
Cuyahoga Falls, C. E. McKahan, C. E., 21,200 Sa, 4,800 B.
East Liverpool, J. N. George, Ch. C. E., 20,000 B, 12,000 Cr.
East Youngstown, H. E. Ruff, St. C., 4,000 ft. Cs.
Fremont, Geo. W. Lesher, C. C. E., 10,178 Sa.
Lancaster, Walter W. Fraf, 10,000 Sa, 18,000 B.
London, H. L. McCafferty, C. E., 53,000 B.
Lorain, Chalmers, C. Miller, C. E., 16,000 Sa, 17,000 Ac, 12,000 B, 15,000 Cr, 1,200 Cs.
Marion, Tom S. Cathers, C. E., 15,500 B.
Marysville, L. B. Harvey, C. E., 3,000 lin. ft. M, 2,000 lin. ft. Cs.
Middletown, W. C. Morrison, C. E., 69,192 sq. ft. Cs.
Niles, F. W. Ward, C. E., 15,000 B, 50,000 sq. ft. Cs.
Sidney, Thaleon Blake, C. E., 1 Cs.
South Point, G. C. Kinley, C. E., 1.58 Tm.
Troy, M. A. Gantz, Civ. E., 20,000 Cs.
Washington C. H., B. R. Jacobs, C. E., 20,000 Sa, 2,000 M, 1,000 lin. ft. Cs.
Wooster, C. O. Williamson, C. E., ¾ B.
Xenia, Kenyon Riddle, C. M., 30,000 Sa.
Zanesville, C. R. Spencer, C. E., 17,000 B.

OKLAHOMA:
Altus, Carl R. Reid, C. E., 2 Cs.
Bartlesville, E. D. Kirkpatrick, C. E., 12,490 C, 66,600 Cs.
Durant, D. C. Lipscomb, C. E., $200,000 C.
Enid, B. F. Lewis, C. E., 150,000 C, 10,000 Cs.
Hobart, C. H. Keiger, 30 blocks.
McAlister, Rose D. Ewens, C. Clk., 5 Cs.
Oklahoma City, B. M. Hart, C. E., 144,150 Sa.

Wagoner, H. H. Hellen, C. E., 1 G, 2,640 ft. Cs.

OREGON:

Bend, Robt. B. Gould, C. E., 58,200 W.
Dallas, Edw. J. Himes, E., 30,000 Ac or C.
Eugene, Harry E. Devereaux, C. E., 20,000 C, 4,000 G, 5 Cs.
Salem, H. M. Rogers, C. E., 20,000 C.

PENNSYLVANIA:

Altoona, F. D. Hain, C. E., 26,000 B, 3,000 Wd, 2,000 Cr.
Beaver Falls, Carl S. Donaldson, C. E., 11,000 Ac, 5,000 C.
Bowmanstown, W. N. Boyer, C. E., ½ Cr.
Bradford, B. A. Wise, C. E., 20,000 B.
Clearfield, E. W. Hess, E., 8,000 B, 1,000 Cs.
Corry, Nevin R. Dickson, C. E., 500 B, 3,000 Cs, 500 Brick Sidewalks.
Dickson City, R. E. Carter, B. E., 4,000 Cs, 3,000 Asphalt Block.
Dormont, E. O. Garrett, B. Sp., 10,000 ft. B.
Dorranceton, B. E., 17,000 Sa.
Duquesne, R. B. Dell, C. E., 16,905 C, 320 B.
East Bangor, H. C. Dilliard, B. E., 1,800 B, 12,000 Cr, 5,000 G, 1,150 Cs.
Easton, C. A. Reese, C. E., 600 A.
Ellwood City, Alex Main, B. E., 6,000 B.
Erie, Theodore Eichhorn, S. S., 160,000 Sa, 32,000 Cs.
Freeland, Theo. Reichmann, E., 10,000 A, 10,000 C, 4,000 G, 2,000 Cs.
Gallitzen, D. W. Dillman, B. E., 3,000 Cr.
Greenville, Chas. P. Clarke, B. E., 3,000 lin. ft. B.
Hanover, A. E. Kohr, B. E., 1,500 Sa, 10,000 M.
Harrisburg, M. B. Cowden, C. E., 66,000 Sa, 54,000 C or Sa.
Huntingdon, J. W. Oatis, B. E., 5,500 B.
Johnstown, H. Lee Wilson, C. E., 11,505 B, 4,257 Cr.
Lebanon, P. A. Volcker, C. E., 40,000 Cr, 100,000 Cs.
Mechanicsburg, Clark A. Bryan, B. E., 5,000 Am.
Norristown, S. Cameron Corson, B. E., 10,000 Tm, 2,500 A, 8,000 B.
Northampton, L. J. H. Grossart, T. E., 2,365 Cr, 650 Cs.
Philadelphia, Fred C. Dunlap, Ch., 25 Sa, 12 Am and Tm.
Pittsburgh, N. S. Sprague, Ch. E., 147,000 Sa, 18,000 Wb, 50,000 S, 7,000 B, 10,000 Cs, 1,000 Asphalt Block.
Pottsville, John H. Strauch, C. E., 11,000 B, 24,000 Wd.
Reading, E. B. Ulrich, C. E., 40,000 Sa, 5,000 B.
Sayre, Nathan F. Walker, B. E., 600 Cs.
Schuykill Haven, Geo. W. Butz, E., ½ Sa.
Scranton, Wm. A. Schunk, C. E., 26,000 Sa, 2,000 S.
Sharon, Lewis E. Burnside, C. E., 6,300 Ac, 14,360 B, 5,000 Slag, 15,000 sq. ft. Cs.
Shipponsburg, T. L. Essick, C. E., 4,000 Cr.
Summit Hill, Roland H. Shinton, E., 3,500 Tm, 5,300 G, 4,000 sq. ft. Cs.
Uniontown, W. L. Dunn, C. E., 10,000 Tm.
West Homestead, C. Edward Long, Con. E., 13,000 B.
Wilkinsburg, Chas. F. Sperling, B. E., 5,000 B.
Woodlawn, M. B. Moore, B. E., 10,000 B.
York, C. F. Waller, C. E., 866 B.

RHODE ISLAND:

Newport, R. I. Easton, C. E., 32,879 Am, 400 M.

SOUTH CAROLINA:

Greenwood, B. R. Cowherd, Jr., Co. E., $50,000 Sa, $50,000 C.
Orangeburg, Edward Huwer, C. E., 65,000 Cs.
Spartanburg, J. H. Shores, S. S., 75,000 Ac.

SOUTH DAKOTA:

Aberdeen, Frank Le Cocq, C. E., 3 Cs.
Rapid City, T. H. Johnson, Con. E., Sioux City, Ia., 56,000 C.
Sioux Falls, S. B. Howe, C. E., 3,800 Cl 2 Cs.

TENNESSEE:

Clarksville, S. R. Alexander, C. E., 3 Ac.
Cleveland, S. D. Newton, C. E., 5,000 Sa, 30,000 Tm, 2,500 Cs.
Dyersburg, S. R. Blakeman, C. E., 10,000 Ac, 1,500 Cs.
Greenville, C. E. Coils, C. E., 4,000 Ac, 2,000 Am, 1,000 C, 100,000 M.

TEXAS:

Amarillo, H. B. Jones, C. E., $450,000 B, 6,000 ft. Cs.
Beaumont, O. A. Seward, Jr., C. E., $200,000 G, 150,000 sq. ft. Cs. $1,050,000 paving, type not yet selected.
Belton, H. R. Smith, Mayor, 8 Am, 12 G.
Bonham, Edgar Whedbee, C. E., 30,000 Tm.
Brenham, Wm. Luck, E., $150,000 C. Base and Uralde Asphalt topping.
Brownwood, Mark E. Ragsdale, C. E., 1,000 Cs.
Childress, R. C. Carraway Co., Con. E., 10,000 B.
Cisco, J. G. Reagan, Asst. C. E., 15,000 S, 3,000 Cr.
Clarksville, Paul Y. Creager, C. E., 300 C, 1,000 Cs.
Dallas, J. R. Graham, E., 150,000 Wb, 80,000 R, 10,000 G, 400,000 Cs.
Eastland, J. A. Wright, C. E., 35,000 Ac, 40,000 B, 5 Cs.
Galveston, Geo. H. Willits, 15,000 B, 15,000 Cr.
Greenville, A. D. Duck, E., 50,000 B.
Longview, H. N. Roberts, C. E., 2,000 Am, 10,000 B.
San Angelo, L. H. Laging, C. E., 8,000 G.
Temple, R. D. Morgan, C. E., 10,000 B, 2,500 C, 30,500 G, 20,000 sq. ft. Co.
Saco, H. R. Seword, C. E., 20 Tm, 25 G, 10 Cs.
Waxahachie, H. R. F. Helland, C. E., 6 Wb.
Weatherford, Geo. M. Parks, C. E., 7,000 W, 10 G.

UTAH:

Brigham City, H. C. Carver, C. E., 4,000 Wb, 4,000 C, 2,000 Cs.
Provo City, G. C. Swan, C. E., 27,500 C, 72,154.6 sq. ft. Cs.

VERMONT:

Barre, Sydney Lee Ruggles, C. E., $5,000 Cr.
Bennington, M. J. Burrington, Jr., Civ. E, 14,000 Cr.
Burlington, Thurman W. Dix, C. E., 1 Tm, 1,500 B, 1,600 Wd, ½ G, 3 Cs.
Rutland, Donald D. Snyder, C. P. W., 12,000 Cr.
St. Albans, J. H. Kennedy, Supt., 1 Tm.

VIRGINIA:

Charlottesville, W. Washabaugh, C. M., 6,000 C, 800 Cs.
Clifton Forge, E. C. Wisterman, Sp. P. W., 6,000 Am, 4,000 sq ft. M.
Danville, Ralph K. Lurville, C. E., 20,000 Sa, 41,331 Ac, 38,788 Am, 9,711 Durax or B.
Fredericksburg, L. T. Houston, Jr., 20,000 G, 3,000 lin. ft. Cs.
Hampton, Girard Chambers, C. E., 3,000 G.
Newport News. E. Russell Davis, Civ. E., 11,874 Tm, 2,802 C.

WASHINGTON:

Aberdeen, A. H. Blood, C. E., 75,000 Cr, 15,000 Cs.
Dayton, Walker Range, C. E., 20,000 Wb.
Okanogan, Horace E. Smith, C. E., 47,459 M, 4,425 Cs.
Olympia, Ray R. Wood, C. E., 10,000 Sa, 2,000 B, 15,000 Cs.
Raymond, Louis D. Kelsey, C. E., 20,000 Cr, 20,000 C, 8,000 Cs.
Spokane, A. D. Butler, C. E., 30,000 Tc, 60,000 C, 10,000 Cs.

WEST VIRGINIA:

Clarksburg, J. R. Wilson, 6 Wb, 3 B, 4 C.
Fairmont, S. B. Miller, C. E., 2,000 Am, 6,000 B, 1,000 C.
Moundsville, Alex Purdy, 2,100 B.
Parkersburg, L. G. Merrill, C. E., 14,230 Sa, 6,370 B, 10,175 Cr, 4,750 C.
Princeton, Elmer C. Barton, Co. E., 4,000 Bit. M.

WISCONSIN:

Ashland, Jas. Phillips, C. E., 40,000 Bg, 4,500 C, 1½ Cs.
Augusta, Henry Olk, Con. E., 5,000 B, 10,000 Cs.
Beloit, G. E. Heebink, C. E., 2,000 Cs.
Eau Claire, J. T. Hurd, C. E., 6,000 Cr.
Edgerton, W. F. Reichardt, C. E., 30,000 Cr.
Janesville, C. V. Kerch, C. E., 2,000 Sa, 4,700 B.
Jefferson, E. B. Parsons, 10,000 Cr.
Kaukauna, Frank M. Charlesworth, Jr., C. E., 24,000 Tm, 20,350 Cr, 5,400 Cs.
Kenosha, P. J. Hurtgen, C. P. W., 40,000 sq. ft. Cs.
Madison, E. E. Parker, C. E., 2 Sa, .33 Wd, 1.00 Cr.
Manitowoc, F. L. Alter, C. E., 50,000 Cr.
Marinette, A. L. Hillis, C. E., $25,000 Tm or B or Cr.
Menasha, A. E. McMahon, C. E., 9,600 Cr.
Neenah, E. A. McMahon C. E., 14,000 Cr.
Oshkosh, G. H. Randall, C. E., 50,000 paving.
Port Angeles, R. J. Young, C. E., 10,000 C, 3,000 G, 5,000 Cs.
Rhinelander, J. G. Johnson, C. E., 5 Blocks M.
Sheboygan, C. U. Bolev, C. E., 40,000 Cr.
Superior, E. B. Banks, C. E., 24,420 Ac, 13,350 Am, 50,000 Cr, 150,000 sq. ft. Cs.
Wausau, B. C. Gowen, C. E., 15,000 C, 5,000 ft. Cs.
Wausau, B. C. Gowen, C. E., 15,000 C, 5,000 ft. Cr.
West Allis, E. G. Orbert, Chn. Bd. P. W., 30,000 to 40,000 Sa or Cr.
Wisconsin Rapids, E. H. Aldrich, C. E., 1,700 B, 19,700 Cr, 22,900 C.

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems different will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

How to Concrete a 2 on 1 Slope with a Slab Lining Having Few Joints

Deliver concrete continuously through chute, place it in alternate panels and anchor reinforcement if necessary to prevent slipping.

DEPARTMENT OF PUBLIC AFFAIRS
* * *, Texas.
March 10, 1921.

Editor, PUBLIC WORKS,
New York City.

SIR: In pursuance of your invitation to readers of PUBLIC WORKS to submit questions regarding construction problems, I wish to request you to advise me as to satisfactory methods for placing a 5-inch concrete lining on two-on-one slopes of an earth embankment, the slopes being about 35 feet in length. It is very desirable to have as few joints in the lining as possible; hence, it is planned to make a continuous slab in each day's work. The concrete will be delivered at the top of the slopes in wheelbarrows. The principal problems are to place the concrete fairly rapidly, spread it uniformly, prevent it from sliding down or sloughing off, and to finish it smoothly but without a troweled surface. Only common labor is available and no special equipment is on hand.

As it will probably take several weeks to have this matter published in your journal, and as we will soon be up to this work, I would appreciate very highly having an advance outline of your suggestions by letter.

Thanking you in advance, I am,

Yours very truly,
* * * * *
City Engineer.

You omit to mention the character of the sub-grade on which the concrete is to be laid, an important consideration that may influence the manner in which the work should be done and the success that can be attained. It should also be stated whether the concrete lining is required to be water tight at the joints.

Assuming that the surface of the sub-grade is hard, uniform and accurately dressed to the slope of the finished slab, the first essentials for the successful execution of the work as required will be the continuous delivery, in sufficient quantities, of a perfectly uniform concrete of suitable proportions and consistency and placing it in position by careful, skilful men under constant supervision of a competent engineer or inspector who should be very exacting.

PREPARATION OF SLOPE

The slope of the embankment should be thoroughly rolled or otherwise compacted and accurately dressed to the required surface. Care should be taken that the surface is not slippery and if necessary it should be finished with a thin layer of fine broken stone, gravel or coarse sand mixture well worked in and compacted. If there is a tendency for the concrete to slip down on the sub-grade it may be wholly or partly relieved by rolling the finished sub-grade on horizontal lines with a slightly corrugated or grooved roller, scoring the surface or making slight ribs thereon to engage the plastic concrete.

There should be built in advance a concrete stop wall at the bottom of the slope and parallel to it to receive the thrust from the lower edge of the concrete slab.

Wood or steel forms as high as the thickness of the slab should be set parallel with each other and from 6 to 12 feet apart extending perpendicularly to the thrust wall, from it to the top of the slope, dividing the slope into panels which should be alternately concreted.

DELIVERING CONCRETE

Close to the top and to the bottom edge of slope there should be laid a single or double-rail track parallel to the wall, the lower track being, if desirable, located on top of the wall. On each track there should be a pair of wheels or a truck supporting one end of an inclined chute for delivering the concrete from the wheelbarrows on top to different parts of the slope. A wheelbarrow runway should be constructed on the top of the slope and adjacent to it for the delivery of the concrete from the central mixing plant and provision should be made for the return of the wheelbarrows without interrupting their constant delivery.

At the upper end the chute should have a hopper for the most rapid and convenient dumping of the wheelbarrows into it. The chute should be parallel with the slope and only a few inches above it, and the lower end should be 2 feet or more clear of the top of the thrust wall. Stop boards and bottom or side gates should be provided at intervals along the length of the chute to permit the delivery of the concrete at any intermediate point between the bottom and the top of the slope.

Any available steel or wooden chute could be used, but it would probably be necessary to

strengthen it to enable it to span the 35-foot length of the slope. If the chute is already trussed, as is often the case with steel chutes provided for use on spouting jobs, the trusses probably project so far below the bottom of the chute that special supports must be provided at top and bottom to raise the truss clear of the concrete slabs. These may make it inconvenient to fill the chute from the wheelbarrow and to deliver the concrete satisfactorily at the lower end, where an additional length may be required to convey the concrete close to the sub-grade.

The chutes can be supported at any elevation between a pair of simple wood, steel, or combination beams or trusses that can easily be made at the site. Timbers, I-beams or channels will serve for the chord members and may be king-post or queen-post trussed with single full length rods bent in the middle and having nuts at the ends engaging beveled bearings at the chords. At the bends they should be supported on saddles or short posts attached to the lower sides of the beams. Light wooden trusses can easily be made with pairs of single 2x4-inch or any convenient size spaced for the top and bottom chords from 12 to 24 inches apart and connected by transverse and zig-zag pieces nailed on. If light deep I-beams or channels of sufficient lengths are available they will serve without trussing but are heavier than trussed members.

CONCRETING IN ALTERNATE SECTIONS

The forms should be rigidly fastened in position with the upper edges exactly in the required plane of the surface of the finished concrete. The chute should be set on the center line of the panel between two successive forms and concrete delivered to it as nearly continuously as possible. The fresh concrete should be delivered at the bottom of the slope and raked into position and to required uniform thickness, building on the upper edge and making the slab continuous from the bottom to the top, the concrete being discharged successively at different parts of the chute as the concrete advances toward the top.

The concrete should be of a rich mixture made with quick setting cement and rather coarse broken stone with finer material and sand very carefully proportioned by experiment to secure the utmost density, eliminate voids and consequently secure imperviousness. It should be mixed with a small percentage of hydrated lime and with as little water as possible to thoroughly wet the cement and aggregate and give a mixture neither sloppy nor crumbly but which will flush water to the top with moderate ramming.

As fast as the concrete is placed it should be screeded off by a straightedge operated on the upper edges of the forms; it should be thoroughly compacted from the bottom up by ramming, tamping or rolling.

REINFORCEMENT ANCHORAGE

If it is laid in this manner and there is still developed a tendency to slip or slough, it may be helped by the use of steel fabric reinforcement in full width strips extending from bottom to top of the slope and temporarily anchored securely at the top. When reinforcement is used, the concrete should be placed in two courses, both of them well tamped; after the first course is laid the reinforcement should be spread over it. Short transverse pieces of steel may be stuck half way through and perpendicular to it at frequent intervals to anchor with both courses of concrete and prevent it from slipping down.

After the top course has been screeded and tamped, it may be finished by a belt, the operation being the same as in highway pavement construction. Any available rubber or canvas belt can be used. It is convenient to attach it to both ends of a long thin board sprung to the arc of a circle of which the belt forms the chord. Handles at each end should be placed at a suitable angle for the most convenient operation of the belt, it should be moved back and forth at a slight angle until the desired finish is secured, working up the slope.

It is most convenient to concrete alternate panels of the slope and as soon as these are finished cover the surface with light working platforms to protect them and permit men to walk around freely on them while concreting the intermediate spaces. In this case the side forms should not be removed until after the concrete is placed between them and care should be taken that the concrete is tamped well against the edges of the existing slabs before the concrete in the intermediate panels is screeded by straightedges working on the first pair of slabs. In this way the intermediate slabs should be concreted before the first slab has set and the concrete can be made practically monolithic for a day's run or if the work is carried on continuously it can be monolithic throughout. The use of two chutes enabling the pair of panels to be simultaneously concreted will reduce the plan of grading between the alternate or intermediate slabs and tend to secure much better bond between them.

The concreting of a steep slope 100 feet wide is described in a paper by V. L. Sullivan, published in the transactions of the American Society of Civil Engineers, May, 1918.

Blasting Down Trees

When a tree is cut down and the stump subsequently blasted splinters are likely to fly that may damage adjacent property.

It is, however, a fact that splinters seldom fly from standing timber, therefore this danger can easily be avoided by blasting down the tree and blasting out the stump at the same operation. A successful example of this was afforded by the removal of nine pine trees, averaging 15 inches in diameter, at Rosemary, N. C. Bore holes were put in on opposite sides of each tree and in each hole there was placed a pound of 40 per cent ammonia dynamite and both charges were fired simultaneously with electric caps and a blasting machine. Ropes tied to the trees about 20 feet above the ground determined the direction of fall, and the trees were brought down, removed from the site and the ground ready for plowing in 10 hours at a cost of $16.

Recent Legal Decisions

CONTRIBUTORY NEGLIGENCE IN DRIVING UNDER OVERHEAD BRIDGE

A farmer bringing a load of hay to market in a city, while sitting on the top of the load undertook to drive under an overhead railway bridge. There was not sufficient room to do so and he was struck by the underside of the bridge, sustaining serious injuries, for which he sued the city and the railroad company. The bridge had been there for many years, the plaintiff was familiar with it, and there was nothing to distract his attention. Reviewing at length the evidence and prior decisions, the Michigan Supreme Court holds, Falchee v. City of Jackson, 180 N. W. 507, that the plaintiff was guilty of contributory negligence, as a matter of law. He saw the bridge and if he had observed he would have known he could not pass under it safely; and if he had alighted and driven his team he would have avoided all danger.

DAMAGES FOR WRONGFULLY CUTTING OFF WATER

In an action again a waterworks company for wrongfully cutting off the plaintiff's water service the jury were instructed that the latter could recover "for the injury sustained, that is to say, humiliation, embarrassment, annoyance and inconvenience," to which the defendant excepted. The Alabama Supreme Court holds, Birmingham Waterworks Co. v. Justice, 86 So. 389, that an instruction, in a case like this, that a plaintiff could recover for "inconvenience" and "annoyance" caused by breach of the contract to supply him with water is not improper, so that the defendants' exception not being restricted to that part of the instruction authorizing a recovery for "humiliation" or "embarrassment" was bad, whatever might have been its merit if so restricted. The inference apparently is that no recovery could be had for humiliation or embarrassment.

CITY OWNING WATERWORKS AND FURNISHING WATER DOES NOT IMPLIEDLY WARRANT ITS WHOLESOMENESS

In an action against a city by a citizen for breach of alleged implied warranty that the water supplied by the city for domestic consumption is pure, wholesome and fit and proper for human consumption and for drinking purposes and free from poison and disease-breeding germs, the question was whether or not a warranty was so created.

While the business of maintaining a municipal water system and supplying water to private consumers at fixed compensation is public in its nature and impressed with a public interest it is not an exercise of governmental or police power. The court cited many decisions and text writers to the proposition that a private water company or a municipality is not an insurer nor liable as a guarantor of the quality of the water it furnishes to its customers in the customary means of pipes and faucets, and cannot be held liable for injuries caused by impure water furnished by it unless it knew or ought to have known of the impurity. Its duty is that of exercising reasonable and commensurate care and diligence in providing an adequate supply of wholesome water at all times.

New York Personal Property Law, § 96, provides that there is no implied warranty as to the quality or fitness for any special purpose of goods sold, with certain exceptions, one of which is where the buyer, expressly or impliedly, makes known to the seller the particular purpose for which the goods are required and apparently relies on the seller's skill or judgment. The furnishing of water, through a system of waterworks, by a water corporation, either private or municipal, to private consumers, at a fixed compensation, is held to be a sale of goods within the meaning of the statute. But it is also held that a taker of water from such a system does not by the mere taking make known, either expressly or impliedly, to the seller the particular purpose for which the water is required, and cause it to appear that he relies as to the wholesomeness of the water on the seller's skill and judgment. It is a matter of common knowledge that human skill or judgment cannot increasingly and under all conditions and circumstances see to it that no unwholesome water is furnished. It is also a matter of common knowledge that a company or municipality does not know that any particular use is to be made of any particular portion taken. Of the water taken the part not used for drinking or human consumption is much the greater. It was also pointed out by the court that the possibilities of contamination are many and varied. There is no conceivable method by which the corporation can absolutely secure and maintain to the water wholesomeness and freedom for pollution. There is no method of analysis or inspection by which the corporation can with certainty furnish and know that it is furnishing no other than wholesome water. For these reasons it was held the plaintiff's complaint stated no cause of action; three of the seven judges dissenting. Canavan v. City of Mechanicville, New York Court of Appeals, 128 N. E. 882.

LIMITED AUTHORITY OF MEMBERS OF BOARDS OF PUBLIC WORKS

A city having been sued and compelled to pay a pedestrian for damages sustained by falling over an obstruction consisting of a cement step, 11 inches wide, leading into the business room of a resident and placed there by him, sued the resident to recover the amount of the judgment. It was held, Sipe v. City of Kokomo, Indiana Appellate Court, 129 N. E. 61, that the fact that a member of the board of public works of the city, out of the presence and hearing of the other members of the board, told the defendant that he might build the step, could not protect the defendant from liability; since Section 8694, Burns' R. S., Ind., 1914, expressly provides that no member of such a board shall have any authority to act on behalf of the board except pursuant to an order thereof regularly made at a meeting at which a majority of the board shall have been present.

NEWS OF THE SOCIETIES

April 11 — HARTFORD SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. City Club, Hartford, Conn.

April 14—SAN FRANCISCO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

April 15 — MERIDEN SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

April 16—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Joint meeting with the Association of Iron and Steel Electrical Engineers. Pittsburgh, Pa.

April 18-23 — UNITED STATES GOOD ROADS ASSOCIATION. Greensboro, N. C.

April 21-22—BANKHEAD NATIONAL HIGHWAY ASSOCIATION. 5th annual convention. Greensboro, N. C. Secretary, J. A. Routree, Birmingham, Ala.

April 22 — METROPOLITAN SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with American Institute of Electrical Engineers.

April 22—BIRMINGHAM SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with Atlanta, Birmingham and New Orleans sections, with members of Council present. Battle House, Mobile, Ala.

April 27—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention. Houston, Texas.

April 27-29—UNITED STATES CHAMBER OF COMMERCE. 9th annual meeting. Atlantic City, N. J.

April 27-29 — BUILDING OFFICIAL'S CONFERENCE. Seventh annual meeting. Cleveland, Ohio.

April 28-29—MID-CONTINENT SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting of Chemical Eng. Societies. City Auditorium or Convention Hall, Tulsa, Okla.

April 29 — EASTERN NEW YORK SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Edison Club Hall, Schenectady.

April 29 — COLORADO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Metropole Hotel.

May 2-4—MISSISSIPPI VALLEY ASSOCIATION. 3d annual convention. New Orleans, La.

May 4-7—NATIONAL FOREIGN TRADE CONVENTION. 8th convention. Cleveland, Ohio.

May 9-11—AMERICAN ASSOCIATION OF ENGINEERS. 7th annual convention. Buffalo.

May 9-12—SOUTHWEST WATER WORKS ASSOCIATION. Shirvin Hotel Headquarters, Oklahoma City, Okla.

May 17-19—NATIONAL FIREMEN'S ASSOCIATION. Twenty-third annual convention. Fort Wayne ,Ind.

May 19 — SAN FRANCISCO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

May 20 — AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. 370th meeting. Engineering Societies Building, New York City.

May 23-26 — AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Spring meeting. Congress Hotel, Chicago.

June—CONFERENCE OF MAYORS AND OTHER CITY OFFICIALS, State of N. Y. 12th Annual Conference. Elmira, N. Y.

June 6-10—AMERICAN WATER WORKS ASSOCIATION. Annual convention at Cleveland, Ohio. Secretary, J. M Diven, 153 West 71st St., New York.

June 7-9—NATIONAL FIRE PROTECTION ASSOCIATION. Annual meeting. San Francisco, Cal.

June 21-24 — AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual and Pacific Coast Convention. Salt Lake City.

AMERICAN SOCIETY OF CIVIL ENGINEERS

The topic of discussion at the March 2 meeting of the American Society of Civil Engineers, held in New York, was the report of the New York-New Jersey Port and Harbor Development Commission. B. F. Cresson, Jr., opened the subject by presenting the report of the committee, whose plan is to make the harbor a railhead port, with the exception of Manhattan, where local distribution and collection of freight would be conducted through a dozen or so zone-warehouse terminals served by a deep tunnel, with two tunnels under the Hudson River, connecting with a joint transfer yard in Hackensack Meadow, New Jersey. Those joining in the discussion were T. Kennard Thomson, Gustav Lindenthal, B. F. Fitch, J. P. Hallihan and G. W. Kittredge, who closed it by urging the support of the society in developing relief for the port of New York.

NORTH DAKOTA SOCIETY OF ENGINEERS

At its annual meeting on February 10-11, the North Dakota Society of Engineers elected the following officers: President, R. N. Stee; first vice-president, E. R. Griffin; second vice-president, W. B. Stevenson; and secretary, E. F. Chandler.

AMERICAN ASSOCIATION OF ENGINEERS

A committee of thirteen prominent members appointed to recommend standard for practical engineers have made a progress report giving tentative schedule for hydraulic, sanitary, municipal and structural work and recommends the preparation of similar schedules for mechanical, electrical, chemical and other services and regular services. The special services defined include: Consultation, arbitration, professional advice, expert testimony, valuations and appraisals, service and efficiency tests and reports.

Regular engineering services include: Reconnaissances, surveys of all kinds, borings, soundings, tests, experimental work and a compilation of all data necessary for the preparation of (a) preliminary reports, (b) preliminary estimates of costs, and (c) plans and specifications. Necessary conferences, preparation of preliminary plans, estimates, and reports covering all features of the work with various alternate plans and recommendation for a solution of the particular problem. Preparation and presentation of working plans, profiles, specifications and estimates for letting of contracts or purchase of material and machinery and for complete information of client or owner.

Attendance and advice at meetings, resident supervision of construction continuously "on the ground," purchase of all materials, equipment and machinery, complete management of project from inception to completion, but not financing. Charges for all classes of "special" work may be placed on a per diem basis and should vary according to the character of the work, its magnitude and importance. The charge should vary from $50 a day upwards. Retainer fees may also be properly charged. Additional charges should also be made for all actual expenses such as traveling and general office expense. Instead of the per diem charge as set forth in the schedule a fixed total sum may be agreed upon. For "regular" services charges may be made on a percentage basis.

NEW YORK SECTION, AMERICAN WATER WORKS ASSOCIATION

At the reorganization meeting of the board of governors of the New York Section, A. W. W. A., held March 2, the following officers were elected: President, George A. Johnson; secretary, Burt B. Hodgman; and directors, Edward S. Cole, Charles R. Bettes and D. W. French. It was decided to hold the section meetings on Friday afternoons instead of Wednesdays from now on, particularly for the convenience of out-of-town members.

NATIONAL BOARD OF JURISDICTIONAL AWARDS

At the spring meeting of the board the representatives of the engineers, architects, employers and contractors and all but one of the international trades unions pledged acceptance of the board's awards. The president of the carpenters alone refused and his resignation from the board was immediately accepted.

The new agreements between the Building Trades Employers and the Building Trades Councils of St. Louis and of Chicago provide that there shall be no stoppage of work because of jurisdictional disputes. The awards made by the National Board of Jurisdictional Awards shall be enforced by the Building Trades Council of St. Louis. Cases not covered by awards of the National Board are to be adjusted by the St. Louis Building Trades Council.

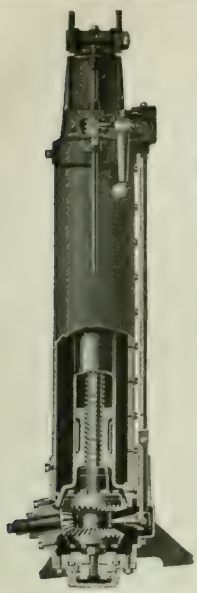
CHAMBER OF COMMERCE OF THE UNITED STATES

The general theme of the ninth annual meeting of the Chamber of Commerce of the United States, to be held at Atlantic City April 27 to 29 will be: "In the public interest more business methods in government; less government management of business." On the day before the convention opens there will be a meeting of the National Council of the Chamber, made up of one representative from each of the more than 1,400 organizations included within the Chamber's membership.

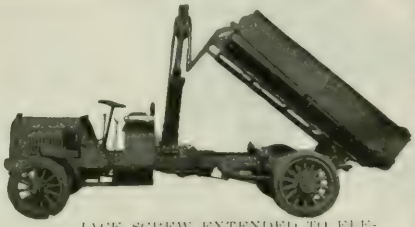
In the first day of group meetings, the group representing Domestic Distribution will discuss current price declines and their effects. Treatment of wages, contract cancellations, better accounting methods and the need of national statistics on production will be taken up by the group representing Fabricated Production. Transportation and communication will be considered under two groups, the first having to do with shipping, and the second, railroad transportation.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



JACK SCREW OPERATED BY BEVEL GEAR



JACK SCREW EXTENDED TO ELEVATE DUMP BODY

VAN DORN DUMP TRUCK BODY HOIST

The dump truck body hoist manufactured by the Van Dorn Iron Works Company is a sturdy compact attachment operating on the screw jack principal that consists of a vertical telescopic cylinder and piston installed on the truck chassis behind the driver's seat.

It is operated by bevel gears from the truck engine and is controlled from the driver's seat by a hand lever operating a 4-jaw clutch that revolves the jackscrew and lifts the end of the truck body through ⅝-inch steel cables, thus utilizing the otherwise wasted power of the engine that is ordinarily left running while the truck is being dumped.

The hoist is designed to easily dump a 6-ton load in 20 seconds at a moderate engine speed. After the body is elevated to the maximum angle of 45 degrees the hoist automatically stops and locks itself until released by hand control, thus making it safe to go under the elevated body to repair the truck if necessary. The device is self-lubricating and so durable that it will outlast several trucks. It is made with four vertical and four inclined bodies, with total height of 59 to 66 inches and widths of 14 inches and 19 inches.

Van Dorn steel dump truck bodies are made of every type for every cargo. Standard bodies of 2, 3, 4 and 5 yards capacity weigh from 900 to 1,750 pounds.

ROLLER BEARING SIDE DUMPING DUPLEX BOXES

GAMMON DUMP BODY

The Gammon side-dump body manufactured by the Pechstein Iron Works was invented by a contractor who had several built for use on road construction work where they reduced transportation cost so much that it was decided to put them on the market.

Each truck is equipped with a pair of steel boxes with four wheels running on tracks transverse to the special truck frame that supports them. They are provided at each end with a gate hinged on the upper edge, and when rolled to one side or the other, dump by gravity on either side of the truck.

The inside dimensions of the boxes are 60 x 30 inches x 18 inches deep, and they weigh 578 pounds each.

They require no gears or small hoists, are perfectly balanced and can be unloaded in less than two minutes. They are mounted on a special structural steel frame and can be installed on the truck chassis in 30 minutes.

EXCAVATING AND EARTH HANDLING MACHINERY

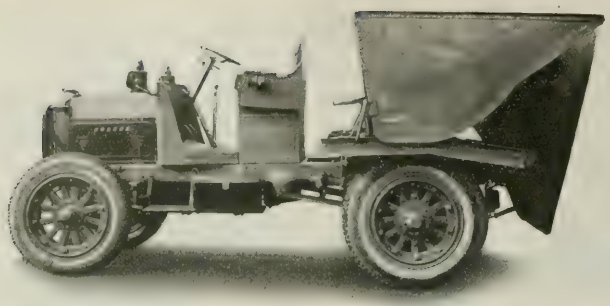
The Cable Excavator Company has issued an illustrated catalog chiefly devoted to a description of the Hadfel Black cable excavators for general excavating work, such as canals, railroads, quarries, sand and gravel washing, screening and loading, sewer and irrigation work, dredging, loading and unloading barges and the like.

The Type A cable excavator has a capacity of 200 to 2,000 yards per day and is operated by three men. Its traveler is movable in a lateral direction, normal to the line of the main cable, and the mast is easily arranged to tilt to the right or left to correspond with changes in the center line of digging. The Type B cable excavator has a bucket supported between two parallel carrying or trolley cables permitting its use where only low towers and small cable deflections are possible.

The Type D cable excavator is most frequently sold and is the most compact, efficient and economical plant for digging sand and gravel from level deposit and delivering it crushed, screened and washed at the foot of the tower ready for shipment. Ordinarily the terminal of this plant is placed on a turntable permitting the excavation to be prosecuted in any direction by merely changing the anchorage at the lower end of the cable. The engine and all other operating mechanism are located on the turntable at a considerable elevation, enabling it to work above adjacent buildings, roadways, etc. The spans range from 200 to 1,200 feet and capacities from 300 to 3,000 tons per day. The plant is operated by only one man.

A number of illustrations show the cableways used for excavating, washing and screening sand and gravel, for stripping overburden, for making concrete piles, for distributing and placing concrete and for digging clay and gravel.

The catalog also illustrates and describes the Parrish flexible arm scraper, cylindrical revolving sand and gravel screens, rock crushers of several sizes, bucket elevators, rock drills, and steel rope fixtures.



2½-TON TRUCK CHASSIS WITH TWO ROLLING DUMP BUCKETS

FEDERAL ROAD BUILDING TRUCK

The road building truck manufactured by the Federal Motor Truck Company has a special 2½-ton chassis equipped with two batch gravity dump buckets for handling wet or dry aggregate.

The buckets are locked in position for transportation and dumped by gravity by revolving around their curved bottom surfaces. It is claimed that a truck thus equipped can haul more batches per day than a 5-ton truck with a single large dumping body and does it at about one half the cost per ton mile of 1-ton trucks and one half the cost per square yard of pavement that is served by 1-ton single-batch haulers. On a given job the truck averaged 74.68 miles per day for one month, hauling the material at a cost of $0.2171 per ton-mile or $0.1495 per square yard of pavement.

INDUSTRIAL NOTES

The Hendricks Manufacturing Co., Carbondale, Pa., has opened a branch office at 915-916 Union Bank building, Pittsburgh, Pa.

Andrews, Tower & Lavalle, construction engineers, Springfield, Mass., have opened an office at 144 West 44th street, New York City.

O. H. Rundquist, Holger Jensen and Oscar Gullickson, of St. Paul, Minn., have incorporated under the name of the St. Paul Manufacturing Co., with headquarters at 1464 Shelby avenue, where they will deal in truck bodies and engage in general contracting business.

George J. Blanton, formerly associated with the General Electric Company and for four years connected with the Engineering Sales Department of the Chain Belt Co., Milwaukee, has been made New York district manager of the latter company.

C. A. Irwin, formerly president and general manager of the LaSalle Cement Co., has been elected vice-president of the Alpha Portland Cement Co., and will have charge of the interests in the territory formerly served by the Burt Portland Cement Co., Bellevue, Mich., the Ironton Portland Cement Co., Ironton, O., and the LaSalle Cement Co. at LaSalle, Ill., all of which companies have been taken over by the Alpha company with headquarters at 140 South Dearborn street, Chicago, Ill. Sales offices will also be continued at Bellevue, Mich., in charge of F. L. McClintock, district sales manager, and at Ironton, O., in charge of J. R. Paul, district sales manager.

The Locomotive Superheater Co., of 30 Church street, New York City, have opened their own company office at 382-388 Union Arcade building, Pittsburgh, Pa. Mr. John LeValley, formerly sales engineer at the Chicago office, has been appointed district manager.

The T. L. Smith Co., formerly of 470 Old Colony building, Chicago, has moved to 1125 32d street, Milwaukee, Wis. This move was made to bring about closer co-ordination between the sales and service departments, the latter of which will be in charge of R. E. S. Geare, general sales manager of the company.

The National Steel Fabric Co., Pittsburgh, Pa., has opened an office at Atlanta, Ga., in charge of H. S. Gibboney, district manager, 604 Walton building.

Homer Niesz has been appointed manager of Industrial Relations of the Commonwealth Edison Co.

National Steel Fabric Company has opened a sales office in the Mutual building, Kansas City, Mo., in charge of H. H. Robinson.

STEEL FORMS

The complete line of steel forms for road, sidewalk, curb, gutter, walls, culvert and post construction, manufactured by the Hotchkiss Metal Products Co., Binghamton, N. Y., will be taken over by the Lakewood Engineering Co.

S. D. Inman has been placed in charge of the engineering and design of the American trolley carrier, monorail conveying equipment for handling bulky materials from railway car to pile, bin or bunker, of the Conveyors Corporation of America.

FRASER, BRACE & CO.

This company of contracting engineers for pulp and paper mills, industrial plants, heavy building foundations, bridge piers, docks, dams, tunnels, hydro-electric construction, mine shafts, shoring and underpinning, announce the removal of their offices to their own building at 32 Pearl street, New York City.

PERSONALS

Petterson, V. S., assistant city engineer of Chicago, has resumed his former duties as chief efficiency engineer in the office of the city comptroller.

Thurman, C. O., of Washington, D. C., has been elected borough engineer of Jersey Shore, Pa.

Baxley, Franklin, has been appointed engineer in charge of the municipal plants of Bellefontaine, Ohio.

Morisette, H. L., has been appointed assistant engineer of the United States Reclamation Service at Yakima, Wash.

Moore, George H., has been made senior electrical engineer of the Public Service Commission of the state of Washington, with headquarters at Olympia.

Osgood, George W., has been appointed manager, as well as chief engineer, for the port of Tacoma.

Caton, John H., 3d, has been appointed director general of public works in Santo Domingo, with headquarters at Santo Domingo City, R. D.

Henderson, W. S., formerly county engineer of Washington county, Kansas, is to become city engineer of Lawrence, Kansas.

Fredendagen, V. B., has been appointed county engineer of Jewell county, Kansas, with headquarters at Mankato.

Dean, M. L., has been appointed consulting engineer for the new road program to be carried out by Walla Walla county, Wash.

Tompkins, Calvin, formerly commissioner of docks and ferries of the city of New York, died in New York on March 13.

Brenton, William H., field engineer for the Interstate Commerce Commission in the Pacific district, died recently at Jerome, Ariz.

J. C. Witt, formerly with the University of Pittsburgh, School of Chemistry, is now chief research chemist, with the Portland Cement Association, located at 1951 West Madison avenue, Chicago.

J. H. Libberton, formerly manager of the Service Bureau, Universal Portland Cement Co., is now with the General Chemical Co., at its offices, 25 Broad street, New York City.

B. J. Latimer has resigned as chief engineer of the Southwestern Portland Cement Co., El Paso, Texas, and accepted the position of superintendent of the Nebraska Cement Co., Superior, Neb.

C. H. Mannion, formerly with the Columbia Sugar Co., Mt. Pleasant, Mich., has accepted a position as chief engineer of the Petoskey Portland Cement Co., Petoskey, Mich.

H. M. Hess, formerly chief chemist of the Monarch Cement Co., is now chief chemist of the Edmonton Portland Cement Co., Edmonton, Alberta, Can.

H. G. Loefler is now with the Monarch Cement Co., in charge of construction.

John Hall has recently been appointed chief chemist of the Monarch Cement Co.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1921, under the Act of March 3, 1879.

Vol. 50 FLORAL PARK, APRIL 9, 1921 No. 1

Substitutes For Sewers

By W. A. Hardenbergh

Most cities have outlying districts not reached by sewers, in many half of the population lives in such districts; and many towns and villages have no sewers. For every such district some public substitute for a sewerage system should be provided. The substitutes in common use are discussed in this article.

A very large proportion of the communicable disease of the average city springs from its unsewered fringe—from that portion of the city lying beyond the sewer limits. The city limits in this case mean nothing. Diseases do not observe any such man-made boundaries. The unsewered area, whether within or without the city limits, is a health problem.

Just what proportion of the disease can be traced to the unsewered area depends very largely upon local conditions, such as the location of the city inside or out of the "typhoid belt," the major diseases prevailing, the unsewered population, etc. Whatever this proportion of disease is, it has been proven many times that the installation of sanitary devices in the unsewered area will practically eliminate typhoid and its allied diseases; it will also reduce very materially other communicable diseases.

The area and population not reached by sewers varies in the different cities, of course. Fayetteville, N. C., until recently reached with sewers but half of its population; Fort Worth, Texas, with a population of 120,000. had one-sixth of these beyond the sewer lines; Montgomery, Ala., Charlotte, N. C., and many other cities have a larger percentage. Brockton, Mass., is practically entirely sewered within the city limits.

It will be seen that most of our cities are confronted with a public health problem of considerable magnitude. The drift to the cities of the past five years, coupled with the factors that during the same period have limited city progress and construction, has intensified the seriousness of the problem. The obvious cure, of course, is to construct sewers, but this cannot always be done. Money may be lacking; geographical or other difficulties, due to an unexpected growth of the city, may require an entire new system of sewers. The question then arises as to what substitutes for sewers are available.

Two conditions are found. A cheap substitute may be needed to stop the gap until, within a year or two, sewers may be built. On the other hand, there may be sections where a fairly permanent sewer substitute may be needed.

No attempt will be made here to give data on the subject such that anyone may apply. Every city has a problem of its own, which requires, for best results, special study. An engineer with experience along this line, or a skilled health officer, will be needed to secure greatest returns for money spent.

The methods most generally used may be classified as follows:

Temporary: Pit; box and can.

Semi-Permanent: Concrete vault and modifications; septic closet.

Permanent: Chemical closets; small septic tanks with running water.

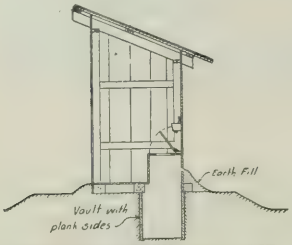
These classifications are not rigid. The second class is called semi-permanent, not because of lack of durability of the structures, but mainly because such installations are rarely satisfactory over a long period. The same is true, though to a much less extent, with the chemical closet. As a matter of fact, however, neither the concrete vault, the septic closet, nor the chemical, is an important factor in city sanitation; their importance is far greater in the rural field.

THE PIT

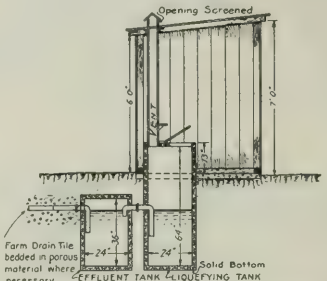
For any community, there is very little to recommend the pit except its low cost. Recent research has shown it to be a dangerous factor in water pollution. Well constructed and carefully maintained, it answers very well the requirements of the rural dweller, but even its enthusiasts can scarcely give it a place in any thickly populated section. It should never be used in any locality where water is obtained from shallow wells.

In those few sections where conditions are such that no other type is possible, and where the

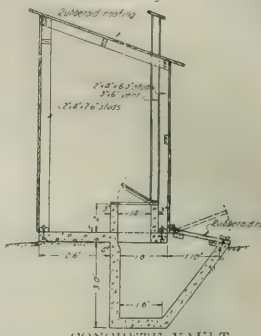
water supply is not from the ground, the pit may be used. The pit itself should be from three to four feet in depth—a greater depth loses the beneficial effect of the soil bacteria—and about three feet square. The pit should be sheeted, when necessary to prevent caving, and should always be curbed and banked to turn surface water. A good seat and lid and good screening to prevent the entrance of flies, as well as a good house, are necessary.



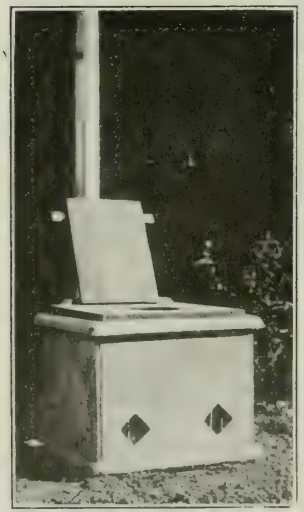
ESSENTIAL FEATURES OF PIT PRIVY



A COMMERCIAL CONCRETE SEPTIC CLOSET



CONCRETE VAULT


CEMENT BOX FOR CAN, ASSEMBLED READY FOR USE

DOUBLE WOODEN BOX FOR CANS, BEFORE INSTALLING IN HOUSE, AT ABBOTT, TEXAS

CAST IRON BOX FOR CAN
Seat raised to lift can out. Screens at bottom front and top rear. Front plate removable for repairing screen by unscrewing three small bolts, and rear plate by unscrewing two.

The first cost of the pit is about $5 to $7. The house, screens and vents will cost from $15 to $20.

A new pit is necessary every year. This puts the first cost at from $20 to $25, and the yearly cost at about $6.

It will be seen that within a few years in any thickly settled neighborhood the soil will receive a very heavy load of pollution. How long this matter will retain its dangerous properties is not known, but it has been amply demonstrated that such pollution is very dangerous to the ground water. Experiments by the Rockefeller Foundation in Georgia, and by Dr. Nesbit, near Wilmington, N. C., have shown that these dangers are real. Last year an experimental board of the Public Health Service traced fecal coli 160 feet from privy pits through ground water in a sandy soil. Even though nothing has been proved as to the ultimate length of travel, nor the time that such pollution remains dangerous, enough has been shown to indicate the danger of using the pit privy in regions where pollution of the ground water would be dangerous.

THE BOX AND CAN

This is probably the most widely used substitute for sewers. Though actually capable of a high degree of sanitation when properly installed and used, the average installation returns little sanitation for the money expended, and usually tends to hasten the advent of sewers through the disgusting fashion in which it is operated.

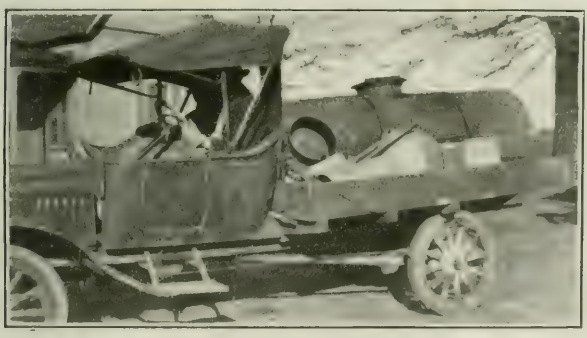
The box and can system is low in first cost, but rather high in operating cost, so that it is especially fitted for a temporary installation. Collection, disposal, can upkeep, etc., should be under municipal direction. Primarily, the system is merely a water-tight can placed under a fly-tight, ventilated box. At regular intervals the pail is emptied and cleaned, or removed, and a clean pail placed in its stead. This requires the operation of a scavenger service.

An intensive study has been made and many improvements initiated in the construction fea-

tures of this type, chief among them being the plan of Dr. L. L. Lumsden, first used at Jasper, Ala., of building the boxes separately and in quantity and installing them later in old or rebuilt buildings. The chief need now is for study and improvement in management, rather than in construction. Substantially no progress has been made in attaining a maximum of sanitation after the installation has been completed.

Of late years, the tendency has been to build single boxes about 20 inches square and 18 inches deep, with a hinged or loose cover to allow the removal of the pail. Metal and even concrete boxes have been used. They are usually better than the wooden box, but the cost is greater.

A questionnaire sent out about a year ago brought returns from about 20 cities operating pail systems of considerable size. The average cost of nine recent installations was about $9 each, for wooden boxes. Commercial metal and concrete boxes cost from $12 to $15, including the can. The cost of $9 included installation in the outhouses. Any installation exceeding in size eight hundred or a thousand boxes can be installed for from $8 to $10 each.



TANK WAGON ON COLLECTION ROUTE
In use in Talladega, Ala., for scavenging can system

Pails before the war commonly lasted 2 to 3 years, but the above questionnaire indicated an average life of only 14 months. This may be increased by coating the pail with asphaltum, or by lining with a newspaper. The present cost of pails is from $1.25 to $2.50 each, according to weight of metal. Scavenging now costs about $7 per can per year, though many cities are now charging only $6 per year. Five years is about the life of an average system, so that we have an initial cost, using the old outhouse of about $10, and a yearly charge of about $9 per can per year, plus a complete new start every five years.

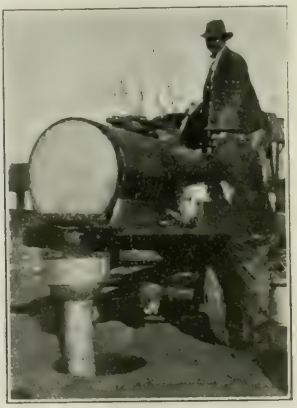
Every box and can system installed has shown a very material reduction in disease, even though it is poorly built and carelessly installed. It has been only lately that the use of copper screening, durable construction, and efficient operation have been particularly stressed. Nevertheless even the shoddy jobs have yielded immense returns in sanitation.

Disposal means will be necessary, and in the average city dumping into the sewers is the best solution. Where this cannot be done, burial, incineration, or tank treatment may be adopted. Collection may be by contract or by city forces. The latter is usually the best.

The advantages of the box and can system are cheapness, simplicity, flexibility, ease and rapidity of installation, and complete community control. The disadvantages are its temporary character, and the ease with which it retrogrades to a condition no better than that which it was designed to remedy.

THE CONCRETE VAULT

This was developed about the beginning of 1917. It was built in large numbers around many of the cantonments, and in several cities. On the whole, it has not been much of a success in city sanitation. In addition to having most of the defects of the box and can, it has several important ones of its own.



TANK WAGON DISCHARGING INTO SEWER MANHOLE THROUGH FUNNEL
On one of principal streets of Talladega, Ala.; no odor or complaints.

As generally constructed, this consists of a concrete box cast in place in the ground, the rear wall sloping to allow for better cleaning, and a partition dividing the box into two compartments of about 75 to 100 gallons each. It was planned to use one compartment; to allow this to cure or dry, while the other was being filled. Drying seems to be the opposite of the actual tendency which appears to be liquefaction. Leakage and overflow aid this latter tendency and generally prevent its operation as planned. There is also the practice quite general in some cities to empty garbage and

CONCRETE VAULT TYPE
Cast outside; to be lowered into the ground.

Data on Some Box and Can Installations

City	No. Cans	Scavenging		Cost Per Month	Installation Cost	Method of Disposal
		How Often	By Whom			
Charlotte, N. C.	1,900	Weekly	By contractor	$3.60	$18.00	Into sewer
Greenville, S. C.	1,100	Weekly	By city	3.00		Into sewer
Chattanooga, Tenn.	6,000	Weekly	By contractor	6.00	5.00	Into sewer
Montgomery, Ala.	5,700	Weekly	By city	6.00		Into sewer
Huntsville, Ala.	1,400	Weekly	By city		10.00	Into sewer
Columbus, Ga.	3,500	Weekly	By city	9.00	7.50	Into sewer
Petersburg, Va.	1,890	Bi-Weekly	By contractor	12.00		Into river
Richmond, Va.	3,000	Monthly	By contractor	4.80	15.00	Into sewers
Alexandria, Va.	1,800	Weekly	By contractor	13.00		Into sewers
Fort Worth, Texas	4,200	Weekly	By contractor	9.00		Into sewers
Hampton, Va.	490	Weekly	By city	12.00	6.00	Into tank
Phoebus, Va.	560	Weekly	By city	12.00	6.00	Into tank
Newport News, Va.	1,880	Weekly	By city	6.00	6.00	Into sewer

dishwater into the vaults. In consequence, it fills rapidly, gives off odor, and cleaning is very disagreeable.

The cost of the concrete vault, exclusive of the house, is about $35 to $40, when built in large numbers. The scavenging must be performed about twice a year (if both compartments are cleaned at one time). To date the scavenging problem has not been solved. An article in this magazine some time ago described experiments with the use of Seco pumping machine for scavenging. This may work in large installations, but would be too costly for ordinary use. Hand scavenging, too, is costly, far from sanitary, and very disagreeable. It is not too much to say that whatever sanitary qualities the concrete vault possesses are lost in the process of cleaning.

This cleaning has become a problem of great acuteness in the cities where this type was built during the war and has been intensified by the lack of foresight, during construction, in locating the vaults in back gardens and other inaccessible places. In general, the prevailing mode of cleaning is to have a negro bail them out with a bucket and empty the contents into a barrel or other receptacle.

Some extracts from a report on an installation of this type in and around Petersburg, Va., will give an idea of the sanitary value of the installation. One hundred homes were visited. Forty-three seat covers were loose; 46 vaults were filled or overflowing; the contents of 59 were liquid or nearly so; fly larvae were present in 54. Most of these had been in use for less than a year, and the result would indicate a rather rapid disappearance of sanitary qualities.

(To be continued)

Bifurcated Concrete Road

It is said that the main state highway between Schenectady and Albany, New York, carries heavier traffic than any other road in the state except for short distances outside of Buffalo and New York City. During twelve hours of an average day in summer 3,735 vehicles of all types passed over the road. About four and one-half miles of this road still remain as bituminous macadam, and it is proposed to start as soon as weather conditions permit on improving a considerable part of this.

The improved roadway will be 24 feet wide and will consist of two strips of concrete, each 9 feet wide, separated by a 6-foot strip of bituminous macadam. The idea, as explained by L. C. Schermerhorn, division engineer of the district, is that heavy trucks will naturally take the concrete tracks along the outside of the road, while the lighter and faster vehicles will use the bituminous macadam central strip for passing them. Another advantage is that only one-third of the roadway will be torn up for construction at a time, leaving the other two-thirds open for traffic. It is estimated that this construction will cost $55,000 to $60,000 a mile.

Water Filtration

Although chlorine, ozone and the violet ray are very effective as sterilizing agents, they only supplement filtration, which last by itself is reliably effective for purification.

Under the title "Filtration As an Independent Means of Water Purification," F. B. Leopold, vice-president of the Pittsburgh Filter & Engineering Company, read a paper before the Associated Manufacturers of Water Purification Apparatus in which he spoke strongly of the necessity for filtering water, no matter what other treatment was given to it.

He briefly traced the history of filtration from the first English filter built about 1830 and the first American slow filter built in Poughkeepsie in 1872, followed by the introduction of rapid filtration in Summerville in 1887 and the development of this type of filter to such an extent that there were on January 1, 1920, 950 filtration plants in the United States, there then being something over 30 slow sand filters. He stated that during the last ten years only one or two slow sand filters had been constructed.

The first filtration plant to guarantee bacterial removal was that installed at Lorain, Ohio, in 1897, where a removal of 97 per cent of the bacteria was guaranteed. The efficiency of filter plants has increased so that they can now be depended upon for the removal of from 99 per cent to 99½ per cent and the usual guarantee called for by municipal filtration plants is 98 per cent.

Reviewing briefly the development of methods of destroying bacteria by copper sulphate, hypo-

chlorite and liquid chlorine, he stated that the last, which was first used about 1911 or 1912, seems at present to be the most practical, cheap and efficient sterilizing agent. Ozone has high efficiency and none of the objectionable features of copper sulphate and hypochlorite, but the high cost of the process and inability to effect mixing with the water have prevented its successful use. The violet ray has been used in several small plants in Europe and this country but while effective it is very expensive both to install and to maintain.

He stated that the possibilities of destroying bacteria by sterilizing agents had tended to create in the minds of many people the idea that filtration was not needed where such agents were employed, and that certain manufacturers of apparatus and dealers in such agents had helped to create this belief. This, he thought, was very unfortunate, because of its possible effect upon public health. A filtration plant without any other assistance removes 98 per cent to 99 per cent of the bacteria in the water and even with the most careless operation the percentage will seldom go below 95. Except by absolutely malicious intention the water must all pass through the filter plant and even with unskilful operation the result will be a very high percentage of removal of all harmful matter. But if only sterilization is relied upon, and the apparatus gets out of order, the entire protection is automatically removed; the percentage of purification is not reduced but the purification is entirely eliminated. Moreover, in order to obtain the highest efficiency from any sterilizing agent, it is essential that foreign suspended matter be eliminated from the water, for the efficiency varies with the amount of suspended matter in the water. Comparatively few plants have duplicate sterilizing apparatus, so that should the one in service get out of order the consumers are left entirely unprotected from any pathogenic bacteria in the water.

Mr. Leopold recognized the importance of sterilizing water after it had been filtered as an additional protection which was well worth its cost, but asserted most vigorously that it should be considered not as an independent means of making water safe but as supplementary to filtration, which latter should be considered as the chief and most reliable defense of the community.

Itinerant Concrete Mixing Plants

Mixer, aggregate and cement carried on a large truck, and concrete for small jobs, distant from the source of supply, mixed on the spot.

The New York Telephone Co. recently constructed a wire conduit or duct subway in the road between Union and Passaic, N. J., which involved the problem of finding a place or method for mixing the concrete. The road was narrow and was lined with swamps on both sides, so that concrete could not be mixed in the roadway and to have mixed it off the roadway would have required platforms in the swamps for both mixer and aggregate at intervals of about 500 feet.

This was a 12-duct subway 6½ miles long, constructed of multiple duct tile with concrete foundation and concrete top protection and with all manholes built entirely of concrete.

To meet this condition the company used a concrete mixing plant mounted on an automobile truck. This was a power batch mixer carried by a seven-ton Packard truck which was also equipped with two gravity hoppers, one for sand and the other for stone, and a tank for water. The aggregate was deposited at points convenient to the job and loaded, the sand into one hopper and the stone into the other by a Portable Machinery Co. scoop conveyor, while the bags of cement require for the batch were taken on at the cement shed. The material thus loaded on the truck was sufficient for five yards of concrete. The mixer was fed by a laborer who shoveled the sand and stone into the mixer from openings at the bottom of the gravity hoppers. Another man added the cement and operated the mixer.

Arrived at the trench, the truck was drawn alongside and a spout set so that the concrete could be delivered directly into position. After a little practice the truck driver found it possible to so regulate forward movement of the truck as to give the required thickness of the concrete in the trench so that little hand-spreading was necessary.

The same company, in building a 24-duct subway between Jersey City and Newark, employed the same portable mixer although there was room

DISCHARGING CONCRETE INTO CONDUIT TRENCH

LOADING AGGREGATE ON AN ITINERANT MIXER

along the roadway for using the regulation mixer, and it is reported that the automobile mixer effected a saving of 25 per cent over the use of mixing stations and dumping the concrete into the trench by wheelbarrows.

Such itinerant concrete plants are used also for doing small concrete construction or repair jobs in different parts of a given locality. Such a plant has been found convenient and satisfactory by B. S. Edward, contracting engineer, of Jersey City, who has equipped a 6½-ton Packard truck with a 4½-ton stone storage bin, a 2½-yard sand bin, a 280-gallon water tank, and storage for 25 bags of cement, enough of all for about 5 yards of mixed concrete.

On the rear of the truck there is installed a ⅓-yard "Knickerbocker" gasoline-driven mixer with an elevating loader and a steel chute for spouting the concrete to position.

This outfit eliminates a large portion of handwork and greatly expedites scattered small jobs, such as setting manhole heads, small conduits, curb, gutter and sidewalk jobs; eliminates the separate delivery of sand, gravel, stone and cement; and concentrates all of the factors for the work so that the jobs need not wait on any single missing link. With this equipment the cellar walls and foundations for a house are completed in one day by the truck and its seven-man gang.

Bituminous Filled Brick Pavement with Lugless Brick

By C. R. Livingston*

Difficulties encountered and devices tried for overcoming them in the effort to secure uniform joint spacing between lugless brick and to maintain it during rolling. Work done last year in Scott County, Iowa.

During the construction season of 1920 the only brick road construction done in the state of Iowa on any of Iowa's primary road system, and the only brick road construction receiving any part of Iowa's allotment of Federal aid funds, was the work done on Federal Aid Project 114 in Scott county. This project is divided into three sections, covering three of the most important roads leading out of Davenport, the county seat of Scott county. The total length of the three sections is 17.28 miles. Owing to the lack of materials and the car shortage of the past year only a little less than two miles has been completed.

One of the features of this work which has caused no little amount of grief to the contractor as well as the engineers in charge of the work is the fact that lugless brick have been used in all of the construction to date and about two million brick of the same type are stored along the roadside for use in finishing about six miles more of the project. The road is of bituminous filled brick construction and is being built under the Iowa standard specifications for Federal Aid road construction in which is a clause which reads as follows: "If lugless brick are used extreme care must be exercised in laying the brick to secure spacing equivalent to the spacing that would be secured if lug brick were used. If deemed advisable, the engineer may require the use of a suitable spacing device between courses to insure uniform and adequate spacing." Our trouble with lugless brick starts the moment we try to follow out the provisions of the above clause, and in spite of the fact that that clause is the source of most of our trouble, I feel confident that our specifications would be very sadly lacking if it were not included. We are not trying to follow the above provisions simply because they are a part of our specifications, but because there is much to be gained by doing so.

Before bricklaying operations started on any of these sections, this clause in the specifications was brought to the attention of the contractors and it was their universal opinion that the natural irregularities in the brick would furnish all the spacing that was necessary to admit the bituminous filler. The first day's work was carried on without much being said in regard to spacing and it was evident to most of us that the spacing was too close to give any reasonable assurance that the joints would be filled. As high as 30 per cent of the brick would be in the doubtful class. Many of the brick would have no visible spacing at all. As soon as this condition of spacing was seen to occur so consistently, the inspectors on the job began to demand that the brick setters pay more attention to spacing the brick, but the results obtained in this manner were not at all satisfactory because the spaces lacked uniformity and some of the brick would still be too close together to admit any filler and other spaces would be as much as a half-inch in width.

Recognizing that it was impossible for the brick setters to obtain any degree of uniformity in the spacing, we placed one man behind the brick setters with a common garden hoe which had been straightened out so that the blade was parallel with the handle, to even up the spacing which had been left by the brick setters by pushing the blade of the hoe into each joint that was too close and thus rearrange the brick on the sand-cement cushion until the spacing was fairly uniform.

With this scheme we thought we had solved the problem of getting sufficient spacing with a lugless brick, but the scheme takes continued and close inspection in order to get a satisfactory job. The problems which arise in the use of this system are more closely akin to psychology than they are to road construction. When the system

* Engineer of Scott County, Iowa.

was first tried out, the contractor brought one of his best workmen back behind the brick setters and explained to him what was wanted and the workman started in a systematic manner to open up the spaces between the close brick and if he saw a brick that he thought should be moved ahead he would put his foot on the brick next to the one to be moved and force the brick ahead by pushing the hoe between the two bricks while his foot held the rear brick to avoid a disturbance of the spacing to the rear which he had already arranged. Within an hour or two he began to slight his work. The first part of the formerly successful operation to be dropped was the holding of the spaced brick with his foot while the bricks ahead were being rearranged. The hoe would still be pushed in between the close bricks, but the open space behind was just as likely to close up as the brick to be pushed ahead. Then a second man with a hoe was put on to assist in the spacing, but it seems that any ordinary workman, after working for about a day at such work, looses his interest in the work and ceases to produce the desired results. The men on the spacing operation were continually being changed in the hope that someone would be found who would put some thought into the work and not lose interest after the first day or so. It was quite common to see a man, after he had been on this work for a day or two, stand in the middle of the street and reach out to the end of the row of brick with the hoe and push the hoe between the end bricks and pull the hoe toward him with a jerk and then reach over to the other end of the row of brick and repeat the operation. The results obtained in that way were just as bad as if the brick had been left as the brick setter placed them, for such procedure was just as likely to close up some spaces that were all right as it was to open up a space that was insufficient.

This haphazard method of spacing continued to the point where the contractor was required to provide mechanical spacers in the form of 1½-inch angles made out of 16 or 18-gauge metal. These angle irons were placed over the edge of the last row of brick set and the next row of brick placed against the angle iron. This way only one row of brick could be set at one time, but by using spacers only one-half or one-third as long as the width of the street either two or three brick setters could work at one time. There is no question but that brick set in this manner could be properly spaced, but there is a little additional cost to the contractor on the item of labor. The season closed two days after the contractor started to use these mechanical spacers and as a result it is hard to tell just how much his output would be reduced by having to use this device. The average number of lineal feet of brick laid in the last four full days preceding the use of the spacer was 409. The number of lineal feet laid the first day the spacer was in use was 340, and the number of feet laid the second day the spacer was in use was 365. This shows that the organization was adapting itself to the new device and I think that in all probability the spacer could be used with but very little more cost than that of the methods previously explained after the men became accustomed to its use.

There are two problems to work out in connection with laying bituminous filled brick pavement with lugless brick. One of the problems is to get the correct and uniform spacing in order to properly admit the filler, and the other, of equal importance, is to keep the displacement of the brick by the roller down to the minimum. The first trip over the brick with the roller is naturally the one which is most likely to cause displacement and as a result has to be done very carefully. After the brick are partially bedded in the sand-cement cushion they can be rolled without further shifting if the roller man uses judgment in handling the roller. The rolling should all be done parallel to the center line of the pavement to avoid any turning on the brick that are only partially bedded. The roller should start at the outside of the pavement and run parallel to the curb line as far ahead as the brick are ready to roll and then pass back over the same path until the roller is back onto the brick that have been thoroughly rolled before any attempt is made to turn the roller.

After the roller has made one trip up the edge of the pavement and back again in the same track, it should make the next trip in such a manner that the roller will lap over the first path half way to secure a uniform surface. After this rolling has proceeded to the center line of the pavement, the rolling should start on the other side of the street and proceed to the center of the pavement as before. This lapping of the roller is expected to give the uniformity of surface that was formerly obtained by the diagonal rolling, but it does not necessitate turning on the brick nor cause the brick to shift under the roller. When the full width of the street is rolled in the above described manner, the paving has had the equivalent of four rollings and the brick should now be thoroughly culled. After the culling is done, the roller should pass over every part of the pavement at least once to bed the new brick in place and to avoid having some of them stick up above the surface so far as to cause the pavement to be rough.

Any turning on brick that are not firmly bedded will cause them to twist under the guide roller when it is turned and cause an uneven spacing. This disturbance is not so noticeable when the turning is done on the brick that have been rolled several times. Another thing that will cause the brick to slide on the sand-cement cushion is reversing the roller too suddenly. The roller should be started and stopped as slowly as possible. People sometimes argue that the small roller should pass over the brick first during the first rolling, but since it is not the vertical component of the force that disturbs the brick, but rather the horizontal component, it is best to allow the large roller to pass over the brick first because there is less of the horizontal component of the rolling force from the large roller when it passes over a brick.

More attention should be paid to the sand-ce-

ment bed upon which the brick are laid when a lugless brick is used than if a lug brick is used. The firmer the sand-cement bed is before the bricks are placed, the less likely the brick are to move. Since the lug brick have lateral support to resist the action of the roller to a greater degree than the lugless brick, more care must be taken with the latter to offset this disadvantage as far as possible. The greatest firmness is obtained in the sand-cement bed when the sand contains only as much moisture as is contained in an ordinary stock pile of sand after a week of warm, drying weather. Fine sand that is absolutely dry as a kiln-dried sand will shift under the weight of the roller and cause each brick to rock slightly, while a sand that contains any appreciable amount of moisture will work up between the brick when the brick are rolled. If the stock pile of sand is exposed during heavy rains it will require several days of favorable drying weather before the sand can be used in the sand-cement cushion without some trouble from the sand coming up between the brick. If the rolling is carefully done and the sand not too wet, the sand-cement cushion should not come up between the brick more than ¼ inch. The contractor who expects to resume bricklaying operations soon after a rain should protect a three or four days' supply of sand from the weather.

The next operation in the construction of the bituminous filled road is the application of the filler. All of the precautions taken so far in the construction have been for the purpose of making sure that the filler would be able to penetrate to the bottom of the space between the bricks. For this reason great care must still be exercised in pouring the filler. The filler should be heated as hot as it can be heated and not injure it, so that it will run into the spaces between the brick better. On the work in Scott county one of the contractors started pouring filler and using rubber squegees, but these had a tendency to cool the filler too much and the filler would in turn stick to the squegee so that the instrument became hard to handle, and did not produce good results. Cast iron squegees were then tried out with much better results, as they could be used hot and kept hot in a fire wagon. To apply the filler successfully a bucket of the hot filler should be poured over an area of the surface of the pavement such that there will be just enough of the filler to about half fill the spaces and the hot squegee should then be run over the top of the brick as hurriedly as possible to get all of the filler into the spaces while it is still in the liquid state. After this application has had time to cool and contract, the operation should be repeated, the second operation being kept a few feet behind the first. Never try to bring the second operation up even with the first except at the end of a day's work. The purpose of this procedure is to avoid dragging any of the filler ahead of the squegee onto the new brick, or rather the brick which have not had the first application. If any filler is pushed ahead of the squegee and out onto the brick which have not had their first application, it will fill just the top of the space and not penetrate to the bottom of the space properly, for the filler pushed ahead of the squegee is naturally much cooler than the filler direct from the bucket and should always be used in the top of a space that is partially filled, which means that it should be used only on brick that have had their first application.

Bituminous filler absolutely will not stick to a damp brick, and about the best test to show whether or not the brick are too damp is made by trying to peal some of the filler off of the brick. If the filler separates from the brick and leaves no trace of filler on the brick when a knife blade is run along the surface of the brick, or if the filler can be made to separate from the brick in any way with the knife, it is an indication that the brick are too wet. If the brick are dry there will always be a thin film of filler adhere to the brick even if it is so thin as to allow the brick to show through.

The above methods of construction grew out of our endeavors to build a first-class pavement with lugless brick and I believe we have succeeded in securing a first-class job. When we were suspicious of the results being obtained by the contractor we confirmed our suspicions by tearing up some of the finished pavement before we asked the contractor to revise his methods. In all cases we have been fortunate in having the co-operation of the contractor, and in laying the remaining fifteen miles of this project next year we expect to learn more of the possibilities of constructing bituminous filled brick pavement with lugless brick. It is my opinion that lugless brick will make a pavement that is entirely satisfactory, but there is going to be a greater cost to the contractor on the item of labor and there must also be more rigid inspection than would be the case with a lug brick.

Columbus to Enlarge Filtration Plant

The city of Columbus, Ohio, expects to let, in a few weeks, a contract for enlarging its water purification works, involving eight new filters, with strainer systems, filter controllers and operating tables, enlarging the enclosing building, 30,000 cubic yards of excavation, 8,743 cubic yards of concrete, 270,000 pounds of steel reinforcement bars, 300 tons of cast iron pipe and special castings, 455 cubic yards of filter gravel and 645 cubic yards of filter sand. C. B. Hoover is engineer in charge and John H. Gregory is consulting engineer.

Pennsylvania Road Work to Begin

The Pennsylvania State Highway Department, during the first week in April, notified those holding contracts for state highway work that they must begin construction work at once. It is expected that work will start two weeks earlier than last year.

When work stopped last fall, 467 miles of durable thoroughfare under contract remained to be completed. Some of the contractors in the southern tier of counties were able to continue rough grading operations during the winter, but this was not possible in the northern sections.

PUBLIC WORKS

Published Weekly
by
Municipal Journal and Engineer, Inc
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.

Subscription Rates

United States and Possessions, Mexico and Cuba....$3.00 per year
All other countries .....$4.00 per year

Change of Address

Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

CONTENTS

SUBSTITUTES FOR SEWERS—Illustrated—By W. A. Hardenbergh 293
Bifurcated Concrete Road 296
WATER FILTRATION 296
ITINERANT CONCRETE MIXING PLANTS—Illustrated 297
BITUMINOUS FILLED BRICK PAVEMENTS WITH LUGLESS BRICK—By C. R. Livingston.. 298
Pennsylvania Road Work to Begin 300
Columbus to Enlarge Filtration Plant 300
EDITORIAL NOTES 301
Before Sewers, What?—Improved Highway Specifications—Reducing Construction Wages
ROAD MATERIALS STORAGE PLANT FOR BERGEN COUNTY 302
THE LABOR SITUATION 303
Special Mud Excavation Classification 305
Public Work to Relieve Unemployment 305
RECENT LEGAL DECISIONS 306
Base and Subbase Failures—Table 307
Pavements Laid During 1920—Table 308
Labor Conditions—Table 309

Before Sewers, What?

Sewers have been laid in less than half the streets of the cities of the United States having more than 30,000 population; and in only a little over one-third of the streets in such cities having under 50,000 population. This statement is derived from the figures of the latest United States census report. (The percentage obtained by dividing miles of sewers in all the cities by miles of streets in such cities is 45.7.) In a number of states the showing for sewerage is very much less favorable.

Sewers are a convenience, but more important is their relation to health. Health records as well as theory show that the death rate is reduced by the introduction of sewers. A city therefore which provides no sewers for three-fourths of its population not only deprives that number of an important convenience but also imperils the lives of them and of the remaining fouth as well. The same applies to smaller cities as well as those of 30,000 and larger.

With the best of intentions and efforts, however, most cities grow on the outskirts more rapidly than the sewers can be extended, and these continually receding areas of unsewered houses are a menace to the city's health.

But the difficulty or delay of providing sewers should not prevent the making of some provision for the health and convenience of the citizens. Temporary substitutes can be adopted without a delay that will prove much better than total municipal neglect and will save many lives. Those in use in different communities are described in the first article in this issue.

Improved Highway Specifications

The Iowa Highway Commission's new classification for the excavation of mud is a very commendable improvement in a much-needed recognition of construction costs that will operate to the advantage of the state and of the contractor. It provides compensation for difficulties not foreseen when the contract is awarded, and if made retroactive so as to cover all work on the contract that is executed before the classification is allowed, should be entirely satisfactory to the contractor.

It should, however, be made mandatory rather than optional with the engineer to allow the special classification whenever a fixed minimum quantity of material handled comes under the fixed requirements. Similar provisions might in some cases be advantageously made for the excavation of rock and indurated material, and for material unexpectedly submerged.

Special classifications are not, however, desirable where it is possible to cover the subject thoroughly by detailed specifications and the latter should be particularly complete and thorough in regard to the different kinds and conditions, and sometimes amounts of various kinds of excavation and of concrete, the latter being clearly defined and limited in the text and unmistakably noted on the drawings and conventionally distinguished there besides.

Reducing Construction Wages

A symposium of opinions of prominent contractors from all parts of the country on the subject of wages, published in this issue, shows enough diversity of opinion to throw light on all sides of the subject. But it is surprising that, in the discussion by experts of a vital subject that dominates their present and future interests, they should have omitted two of the most important essentials, namely that the wages should to the utmost possible extent conform absolutely to efficiency, no matter how high or how low it may bring them, and that those in the engineering field should bear a just proportion to those in other industrial pursuits, including shop and factory in which the downward trend is already well advanced, as well as in other forms of labor, especially in trained and responsible positions of brain workers that are excessively underpaid.

The contractors also neglected to recognize the very pertinent fact that during and since the war labor has been most conspicuously a favored class and by reason of its general practical exemption from direct taxation of any form and by the mad

pace with which politicians scrambled to raise wages much faster than the cost of living, labor has been exempted from the war and industrial burdens of the country and has been encouraged in arrogance, extravagance and inefficiency. The day of exorbitant war profits is past and labor and other profiteers must rapidly return to giving a fair equivalent for money received.

Road Materials Storage Plant for Bergen County, N. J.

Bergen county, N. J., has about 160 miles of roads paved with various types of bituminous construction. It also has about 67 miles of roads which are surface treated with bituminous materials, and the annual consumption of bituminous materials of all kinds on new construction and surface treatment and repairs is about 1,500,000 gallons. The Board of Chosen Freeholders and the supervisor have decided that a complete road materials storage plant, providing adequate storage facilities for bituminous materials required for road construction and for surface-treating, is in accord with good business policy and will prevent delays incident to the difficulty of obtaining prompt shipments during the busy season. If at any time the supply on hand is in excess of the county's requirements, the authorities contemplate furnishing material to municipalities or to contractors working upon their roads.

The plant is to be located in County Yard No. 2 at Hackensack, N. J. This yard is situated on the Erie Railroad and the county authorities have constructed a railroad siding on the property. Bids for the plant will be received in a few weeks. (See advertisement in this issue.) Plans and specifications for the plant, which is to be a model of its kind, have been drawn by Dow & Smith, consulting engineers of New York City.

The plans call for four 50,000-gallon storage tanks and two 4,000-gallon heating tanks, a boiler and boiler house, two 10,000-gallon fuel oil tanks, two pump houses, each containing a rotating plunger pump; also a cement storage warehouse.

A railroad siding runs along the easterly side of the plant, which is arranged with the tanks and warehouse in a row extending approximately north and south. The rails are two feet below the platform surrounding the tanks and the boiler house floor, and 4 feet 3 inches below the storage warehouse floor. Along the west side of the plant runs a roadway six feet lower than the railroad siding, or 10 feet 3 inches below the level of the storage warehouse floor. A retaining wall is to be constructed along the east side of the roadway.

The plant occupies a space 284 feet long and 50 feet wide, and this space is as completely occupied by the tanks and buildings as is possible without overcrowding. Fourteen feet of the width is occupied by the track; the roadway borders the property on the west.

Each of the four storage tanks is 21 feet in diameter and 21 feet high and has a capacity of 1,000 50-gallon barrels. They are insulated by means of 6-inch hollow tile walls built around them, and are provided with sufficient steam coils to keep the material in a fluid condition. Each tank is surrounded by a dam wall two feet high to take care of any overflow or boiling over of the material.

A heating tank is located between storage tanks Nos. 1 and 2, and another between Nos. 3 and 4. These tanks are insulated with magnesia blocks and are provided with a steam coil installation relatively larger than that of the storage tanks, so that in them the bituminous materials can be heated to the temperature required for application on the road. These tanks are 8 feet 2 inches in diameter and 15 feet long, resting on their sides in pillow blocks. These tanks will be filled by gravity from the storage tanks except when the material in the latter is at a very low level.

In each of the same two spaces between the pairs of tanks (which is 45 feet 8 inches center to center) is located a pump and pump house. The bituminous material and fuel oil will be received in tank cars on the railroad siding, and each pump is arranged to unload such cars into two of the storage tanks and one of the heating tanks; but the piping is so designed that in case of a breakdown either pump can be connected up so as to take care of the other tanks also. These are rotating plunger pumps.

The steam for the plant is generated in a boiler house of appropriate design and constructed of reinforced concrete and hollow tile, 32 by 36 feet outside dimensions. The boiler is 50 horsepower. Fuel oil is burned under the boiler, being stored in two 10,000-gallon tanks buried under the ground just outside the boiler house, which are filled from cars on the siding by means of a duplex piston pump and are connected up with the necessary burner pumps and steam connections.

All the pipes provided for carrying bituminous material are steam jacketed and provided with the necessary air connections so that they can be blown out after use. They are carried two feet above the ground level and rest on top of the dam walls, thus rendering them easy of access when repairs are necessary. There are also the necessary fuel oil, water, steam, exhaust, air and drain pipes.

On the westerly side of the plant a road has been constructed six feet below the level of the railroad siding. The necessary swing pipes have been provided for the discharge of the heated bituminous material by gravity into tank wagons on this roadway, thus minimizing the amount of pumping required.

All tank foundations and retaining walls are to be made of reinforced concrete.

The plans also call for a concrete and hollow tile cement storage warehouse 25 feet by 40 feet, and 10 feet high, with unloading facilities at the railroad siding and delivery facilities at the road above described.

The Labor Situation

Associated General Contractors of America in convention at New Orleans discuss reduction of wages, open shop, union labor and apprenticeship.

Prominent contractors, associated with many kinds of important construction work throughout the country, discussed wages, unions, open shop and apprentices at the New Orleans convention last month and while differing in details and sometimes in essentials, the preponderance of opinion was in favor of reduction of wages, open shop and education of labor, both mentally and mechanically.

The principal speakers said, in part: W. L. Wimmer, of St. Louis—Recently the general contractors of St. Louis led in the forming of an association between general contractors and subcontractors which includes only those who at present employ nothing but union labor. It has been our custom to make contracts with the labor unions separately for the different trades, and between them and their separate employers' associations. During or just after the first of this year we appointed a committee consisting of one member for each of these sub-contractors' associations and one from the General Contractors' Association, and, together with a similar committee of all the building trades unions, we are trying to hammer out some more definite and harmonious relations.

SHALL WAGES BE REDUCED NOW?

The very first question was, "Is it advisable at this time to have a reduction of wage commensurate with the reduction of costs of all other commodities and all other pursuits of commerce?" To answer it we are now collecting necessary statistics.

T. A. Pearson, of the Fred T. Lee & Co., Inc. —The Building Employers' Association in Boston has made the agreements with the building trades as a whole, not individual agreements, and it was very successful until the first of January, when they expired, and at that time the unions asked for an increase to a dollar and a half an hour for mechanics. In order to combat the increase, the association offered them—after not being able to agree on keeping the wage at $1—ninety cents an hour. We had a strike. The trend of the New England States, I believe, at the present time, is to maintain in force the wage which was in force during the past year until either April or June of this year.

The agreements that we have made in other parts of New England have been at the rate for the past year and will run until the first of April. Any change to be made after the first of April will be discussed during the month of March, when business conditions will be more settled and we will be able to judge in a far better way what business there will be this summer. If it's going to be good, undoubtedly we will revert anyway to the conditions that existed last year and if it's going to be poor, then we can get a reduction.

Mr. A. J. Krebs, of Atlanta—The General Contractors of Atlanta decided, last December, that we would pay the laborers thirty cents an hour, the present wage of the laborers being forty cents; that we'd pay the carpenters seventy cents an hour, their present rate being eighty; the painters, we'd pay seventy cents an hour, their present union rate being a dollar; and the brick masons, ninety cents an hour, their scale then being a dollar and twelve cents, with all the balance they could get.

That was promulgated on the first of January, with the understanding that any contractor who had a job to finish could continue to pay the scale, and the result has been very successful. There were in some instances men who were pulled off the jobs, but the contractors hired other men and went on with their work. Apparently there is no evidence of a strike in Atlanta at all. I believe those wages will stick, if the conditions of the times come out as we expect. There will be a reduction in all kinds of living costs; probably rents are about the only thing that haven't come down and that is on account of the dearth of houses, but altogether that seems to be quite settled and, although the unions are all going to make a fight to hold their present rate of wages in Atlanta, I believe it will stick.

REDUCE TO CORRESPOND WITH LIVING COSTS

E. J. Thomas, of Memphis, Tenn.—The proper way, and the only way it can be reached, where you're going to do collective bargaining, is to go into the scientific analysis of how much living costs have been reduced, and until we arrive at that point where we know, let us take the high peak. If we take the high peak of wages and the high peak of living costs and the living costs have been reduced a certain percentage as a whole, I think the price of labor should come down, because unquestionably labor itself must acknowledge that they were well paid at the peak prices. The question is how to arrive at the proper percentage of reduction.

Unquestionably any man that is a man, and entitled to be in the contracting business, should feel for his men and have interest in their welfare, but we've got to get away from that, the contractor has got to decide what we are going to do relative to this wage question and then use every effort possible, I think, by persuasion and education, with our men, to make them see the light as we see it.

But suppose that we are not going to be able

to make them see it: suppose we show them that living costs by April will be reduced 20 per cent or 25 per cent (which I am sanguine will be the case), and organized labor refuses as a whole, or in their separate communities, to meet a reduction commensurate with the reduction in the cost of living; what are we going to do? What stand are we contractors, representing the industry, going to take? I believe that a 20 per cent or 25 per cent reduction in the high peak of wages is just and right.

It is contrary to the statistics of the Labor Department of the United States, which only, I understand, claim, that living costs so far, as a whole, have been reduced around 6 per cent. I do not take that to be 100 per cent true. I believe that in my own household my living costs have been reduced more than 6 per cent, and in your household your living costs have been reduced more than 6 per cent. I am simply taking that as a general law of average.

Mr. Pearson, of Fred T. Ley & Co.—As a matter of fact out of 116 commodities, living has decreased 38 per cent. It has also increased since 1914 or 1915 143 per cent. Now, which are you going to take for a basis for paying your labor —1914-15 or 1919-20?

I believe the thing that we should do is to find out how much it costs a man to live, whether he is a mechanic or whether he is a laborer, and that is the point that we should begin to base our prices on. We say we are going to wait till the first of April. The first of April things will be settled. We may be able at that time to determine what a living wage is, but until things get settled we cannot do that and I don't believe it is fair to either increase or decrease, just because the low price was in '14 or the high price was in '20.

PUBLIC DEMANDS REDUCED WAGES

Mr. Holladay—You can't get a contract unless the public is ready for that contract. You can't carry a single point, union labor or non-union labor or any principle that you have in your organization, any business principle, unless the public is with you, and the public will defeat you every time you take a stand against the public.

Now, the public all over this country is ready for a reduction in wages. If this association comes out and says that you favor labor coming down, I don't say union labor or non-union labor, but if you favor labor coming down in line with the living expenses, go on record all over this United States; you will have the public behind you. You will have the same situation in your town; I don't care where you come from; but if you sit back and say, "We're afraid to say we want labor to come down," and if you, up in your community, when the question comes up between the labor organization and you, go and sign a contract with them for another year on this present wage basis, the public won't build, they will say, just as they did about clothes, "We won't wear clothes"; or just as it has been said about sugar, "We won't eat sugar." If you want building to start, if you want to increase your profit, if you want to carry your organization, if you want to get through this year without having to pay your overhead, and without having to use up your surplus, block this proposition!

THE OPEN SHOP

Mr. A. J. McKenzie, of San Antonio—We have never signed a contract with a labor union. About a year and a half ago the labor unions imported a number of agitators into San Antonio to close up the town in order to control government contracts. We immediately formed an open-shop association and our main trouble was handling the other contractors rather than handling the labor unions, and as soon as we handled the other contractors, we never had any more trouble with the labor unions.

At the present time we are working probably five hundred men, 60 per cent of whom are union men and 40 per cent non-union, and I haven't had a walking delegate in the office for six months.

Some time ago the Texas Section of the A. G. C. was formed and the reason of its being formed was for the purpose of collecting the data in the various cities and furnishing the rest of the cities with that data with reference to wages. Our union men would go to one city and raise the wages and then go to the next city and tell the people there that wages were higher up in Houston than in San Antonio, and then capture San Antonio and go to Dallas, capture Dallas, and then go to El Paso and raise their wages, and as soon as we formed our organization and furnished each city with the actual facts in the rest of the cities, we soon broke up this situation.

I think the best thing we could do would be to obtain the information with reference to the actual cost of living and furnish it to the various contractors in the various parts of the country. Our position is that the price of labor is a question of supply and demand and we worked on that basis.

We are working the union men one job and the non-union men another place. They don't work together on the same job. We hire a foreman and put him on the job and he hires his own men.

When we formed the open shop, we immediately began working on the man who let the contracts, and we are getting architects, engineers and owners to specify that it's got to be open shop. That's the way we killed the whole proposition. That doesn't mean that we can't work union men, it doesn't mean you can't work union men.

Chairman Bentley—I have on my desk an item clipped from the Tulsa, Okla., Gazette, in which there is a bank advertisement that says that the bank will not loan any money for any building improvement or any public improvement unless the specification and the contract is drawn and guaranteed that that job will be run open shop.

Now, that brings you back to the question, what is an open shop? Is it an organization of mechanics and laborers who do not belong to organized labor? Or is it an amalgamation or a mixture of what we term or what the public terms open shop?

T. T. Flagler, of Atlanta—I think the general trend of the times is towards an open shop. An open shop automatically regulates wages in accordance with the law of supply and demand and I think that if we start making any specific recommendations at this time, we will make a mistake. We are acting on a question which has been pretty thoroughly thought out and before we take any definite action, I wish that everybody here would read the report of the Committee on Labor.

For instance, "What is an open shop?" has been asked. In Mr. Wason's fundamental principle it says, "The right of employer and employee to enter into and determine the conditions of employment relations with each other, without reference to the affiliation or non-affiliation of either with any organization. It is an individual right of free contract possessed by each of the parties."

Now, that has answered the question of the open shop. If you will read these principles, and I think you all have copies, you'll find The Employment Relation, Right of Association, Responsibility of Combinations, Obligation to Secure Production, Wages and Management, Hours of Labor, Adjustment of Employment Relations, Community of Interest, Government Employment and all other matters pertaining to this are thoroughly and splendidly covered in this report.

BUSINESS HEADS MUST GOVERN

The Chairman, Thomas Bentley—Personally, I feel that labor, like everything else, is a matter of competition. I don't believe that the time will ever come in the world when it will be free from labor problems. It would seem to me that the man who is the head of a business employing men who work with their hands has got to be the guiding star of that organization. Whether he sees the light of leading his people individually or collectively, will be a matter of personal judgment.

I think I see in the not very distant future the time when the cessation of work through labor disputes will cease. I believe that organized labor, like anything else, has passed the peak of its power and that the time is not far distant when that body of men, like any other body of men, banded together for personal benefit, will have to begin to see the other fellow's point of view.

To me, as a man who has always been a very, very strong adherent of the open shop, the fundamentals as laid down by the American Federation of Labor, would be one of the grandest things that ever could come into practice, but organized labor, working as it has done, continually upward to its own destruction for the last fifty years, cannot go on and consequently they will have to go back to their fundamentals which are right, and when they get back to those fundamentals, the cessation of work through strikes called for financial reasons, working condition reasons and so forth will cease. It is coercion that has led the average man who belongs to organized labor to participate in the drastic things; he hasn't done it from his own choice.

APPRENTICES

William Ford, of Janesville, Wis.—What are we going to do to replace mechanics; there are no young men entering the trade?

I, for one, am an advocate of fair pay for fair service. We must do something to induce the younger man to follow up the work that we have started. I think that is the apprenticeship question, if you want to call it so, and one that we should think a great deal about and give a great deal of attention to.

Special Mud Excavation Classification

The Iowa Highway Commission has, after strenuous efforts by the contractors, established a new classification to cover the excavation of materials which do not properly belong under the classifications of "ordinary earth" or "loose rock" and are much more difficult and expensive than dry earth to handle. When it is demonstrated that under normal conditions and efficient operations the output is decreased 50 per cent by the wetness of the material, the engineer may make the special classification unit price. The specification is:

Class 2, Special. If in the normal progress of the work material of a nature is encountered which is in natural condition and not in a condition resulting from temperature or weather conditions, and which does not properly come under the classification for Class 1 or Class 2, and is more difficult and expensive to handle than is contemplated for material under Class 3, the engineer may, upon demand of the contractor, give such material a Class 2, Special, classification, under which classification double the price bid for Class 3, Earth Excavation, shall apply. The Engineer shall be guided in giving this classification by the output of the crew employed, under normal and favorable weather conditions; and such a classifitation shall not be given unless the output of the same crew is decreased by 50 per cent over the average output maintained in material which on the same work is classified properly under Class 3, and unless the contractor uses the ordinary tools, equipment and methods necessary to give the most efficient results.

Public Work to Relieve Unemployment

The city of Waltham, Mass., in February began acting to relieve the unemployment situation by starting grading a steep section of road, cutting down a gravel hill and using the material to raise the road over low land on each side of it. The first morning sixty men applied for work, but only twenty could be used, preference being given to married men, to those who had been in the army and those who were neediest. Six of these failed to show up the second day but others took their places, a number of additional men reporting every morning in hope of work. Later two shifts were worked, one the first three days of the week and the other the last three days. By the end of the month two shifts of fifty men each were at work, and it was said that this might be increased to seventy each, which is about the maximum that can be handled.

Winston-Salem is believed to have done more paving during 1920 than any other southern city with the possible exception of New Orleans. Nine miles, or 175,625 square yards, of various kinds of pavement were laid at a cost of $534,064; this including regrading many streets, lowering water mains, and replacing some with new ones of large size. In addition, the street railway did considerable paving.

Recent Legal Decisions

NO LIABILITY OF CITY FOR INJURY TO GARBAGE DRIVER AS SPECIAL EMPLOYEE AFTER SPECIAL EMPLOYMENT ENDS FOR THE DAY

The driver of a garbage wagon employed by a contractor who contracted with the city of New York for the use of his team with driver at so much a day, the driver reporting to the city's section foreman, who directed him when and where to load his wagon with garbage and ashes, was killed when a wheel came off his wagon after he had unloaded it and was returning to his employer's barn. In a claim against the city under the Workmen's Compensation Act, the New York Appellate Division holds, Backey v. City of New York, 184 N. Y. Supp. 495, that the deceased was not, at the time of the accident, in the employ of the city, his special employer, which could not be held liable, the deceased not having been injured by an accident arising out of and in the course of his employment in removing ashes or garbage, provided for in subdivision 13, section 3 of the act. After the work for the city was done for the day, the deceased reverted to the complete control of his general employer; he was managing and caring for the team, and the accident arose out of and in the course of his employment in driving the team back to the stables of the general employer.

PROVISION IN BOND TO CITY AS TO DILIGENCE IN SERVICE OF PROCESS THEREON MUST BE OBSERVED

The West Virginia Supreme Court of Appeals holds, City of Elkins v. Elkins Electric Ry. Co., 105 S. E. 233, that a provision in a bond given to indemnify a municipal corporation for any damages that may be sustained by reason of the failure of a street railway company to replace city streets injured by it in removing its tracks therefrom, which requires any suit on the bond to be brought before a specified day, and the principal to be made a party thereto, and served with process before that date, if that can be done by the exercise of due diligence, is valid and binding on the parties. The delivery of such process to the sheriff with directions to serve it upon the principal within the time named does not constitute due diligence where the sheriff fails to make the service and it is shown that it could easily have been made within the time provided by the contract.

SUBMISSION OF BOND ISSUE FOR PURCHASE OF UTILITY TO VOTERS

The South Carolina Supreme Court holds, Commissioner of Public Works of Summerville v. Bank, 105 S. E. 32, that in submitting an issue of bonds for public works to the voters of a municipality, where the purposes are entirely separate and distinct, as, for instance, the issuance of bonds for water works and sewerage, the questions must be separately submitted; but separate questions, germane to or involved in one main purpose, need not be separately submitted; for instance, whether bonds shall be issued to purchase, repair and extend an existing system of water works or an electric light plant, because they are so closely related to and involved in the main purpose as to amount to but one question —that of supplying the people with water or with light.

It is also held that the fact that there is an ice manufacturing plant in connection with an electric lighting plant to be so acquired, which is to be included in the purchase as a part of the latter, is no objection to the validity of the bonds. The purchaser of the bonds is not bound to see that the commissioners apply the proceeds to the purposes intended, and no other. He may assume that they will proceed according to law in the performance of their duties.

ILLINOIS CITIES MUST PAY COMPENSATION TO INJURED EMPLOYEES OF UNINSURED CONTRACTORS

The Illinois Supreme Court holds, City of Chicago v. Industrial Commission, 129 N. E. 112, that under section 31 of the Workmen's Compensation Act, requiring employers to pay compensation to their own employees and to the employees of uninsured contractors, a city is liable to an injured driver of a wagon of an uninsured contractor who furnished to the city a team, wagon and driver to haul ashes, etc., for the city under the direction of city officers, although Section 5 of the act provides that a contractor's employee shall not be considered an employee of the city which made the contract.

MUNICIPALITY CANNOT GIVE RAILROAD EXCLUSIVE USE OF A SUBSTANTIAL PART OF A STREET

The Tennessee Supreme Court holds, Stewart v. Illinois Cent. R. Co., 225 S. W. 1042, that, since public highways belong from side to side and from end to end to the public, and abutting owners have special rights of ingress and egress, a municipality cannot grant a railroad company a right of way in a street which would amount to an appropriation of the exclusive use of one-fourth of the street.

NO LIABILITY FOR CONTRACTOR'S NON-PERFORMANCE CAUSED BY DELAY OF STREET RAILWAY COMPANY OR CITY

Streets to be improved were traversed by the tracks of a street railway company, which was required by the ordinance under which the improvement was made to relay its tracks of eight-inch T-rail in place of the five-inch rail then in use. This the company never did, because war prevented obtaining the necessary steel. The improvement contract provided that the contractor should not bear any liability for delays on the part of the street car company. In an action on the contractor's bond it was held, Board of Council of City of Frankfort v. Fidelity & Casualty Co. of New York, Kentucky Court of Appeals, 225 S. W. 1076, that there was no liability on the bond for non-performance of the contract if it was impracticable to build the street until the street car company first put down its eight-inch steel, or if the city authorities interfered to prevent the construction company from proceeding with the work until the steel was laid.

Base and Sub-Base Failures

City and state	Kind of base	Thickness	Wearing surface	Failure due to traffic	Kind of traffic	Failure due to yielding subsoil	Probable cause of yielding
Arizona:							
Douglas	Concrete	4–5	2-in. m	No		Yes	Sub-soil dry and loose
Arkansas:							
Pine Bluff	Concrete		Brick and A.C.			Yes	Pipe trench; lack of drainage
California:							
El Centro	Concrete	5	2-in. bitulithic	No		Yes	Swelling sub-soils becoming wet from broken water main or irrigation water
Pasadena	Concrete	4	Asphalt	Yes		Yes	Service ditches and poor maintenance of railway allowed water to penetrate sub-soil
Georgia:							
Augusta	Macadam	6	2-in. A.C.	Yes	Government trucks	No	Poor construction
Illinois:							
Cairo	Concrete	5	Brick	No		No	Trenching for water, gas, sewers
Cicero	Concrete	6	Sheet asphalt and brick	Yes	From 1 to 15 ton vehicles	Yes	Pipe trench and settlement of new embankment
Evanston	Waterbound Macadam	14	Limestone	No		Yes	Marshy sub-soil and lack of sub-drainage
Oak Park	Concrete	6	A.C.	Yes	Heavy truck traffic		
Wilmette	Macadam	6	Brick	Yes	Truck traffic	Yes	
Indiana:							
Crawfordsville	Concrete, gravel	6	Brick	Yes	Too heavy for gravel base	Yes	With concrete base, sewer trench and poor drainage—worst place due to leak in water main
Marion	Crushed stone and gravel	8–10	Brick or sand cushion	Yes		Yes	Lack of drainage
Kansas:							
Salina	Macadam	6	2-in. A.C.	Yes	1.5 ton trucks and autos; 3,000 a day	No	Bad mixture of asphalt and aggregate
Massachusetts:							
Webster	Crushed rock	6	Tar and asphalt	Yes	5,000, 10% heavy auto trucks	Yes	Partly embankment—mostly trucks at high speed
Michigan:							
Saginaw	Concrete	6	4-in. brick 2½ in. asphalt	Yes		Yes	Old trenches show decided settlement
Minnesota:							
Chisholm	Concrete	5	4-in. cresote block	No		Yes	Pipe trenches and settlement of embankment
Mississippi:							
Tupelo	Concrete	4½	Sheet asphalt	Yes	Constant traffic		Expansion
Missouri:							
Brookfield	Loose rock	8	3-in.	Yes	Narrow wheel coal wagons	Yes	Pipe trench—lack of drainage
Maplewood	Concrete	4	Bitulithic	Yes	Heavy trucks—800 a day	Yes	Lack of proper drainage
Poplar Bluff	Clay	6	Delarnay	Yes		Yes	Lack of drainage
St. Louis	Telford and concrete	6T 4 SC	Asphalt and bitulithic	Yes			Ground water in clay soil
Nebraska:							
Nebraska City	Concrete	5	2-in. A.C.	Yes	200-300 autos and trucks	No	
New Jersey:							
Orange	Concrete	6	Wood block			Yes	Settlement of pipe trenches
West New York	Concrete	5–7	2-in.–3-in.	Yes	2,000 to 12,000 lbs. 500 to 1,000 vehicles a day.	Yes	Pipe trench
New York:							
Albany	Rolled gravel	10	Brick	No		Yes	Due to high ground-water level and frost going out of ground in spring
Elmira	Concrete	6	Brick	Yes			Pipe trench
Glens Falls	Concrete	6–8	Red brick and Mack block			Yes	Pipe trench and settlement of new embankment
Jamestown	Concrete	5	Brick asphalt block and macadam	Yes	Heavy truck traffic	Yes	Pipe trenches, lack of drainage and unconfined quicksand pockets
Lockport	Concrete	6	Asphalt block	No			Settlement of pipe trenches
Plattsburgh	Concrete	6	Vit. brick	No		Yes	Lack of drainage
Port Chester	Concrete	6	Brick	Yes		Yes	Trenches and traffic and excavation
Syracuse	Concrete	6	Brick	No		Yes	Lack of drainage—possibly quicksand
Utica	Concrete	5				Yes	Pipe trenches and new embankment—excavations
North Dakota:							
Fargo	Concrete	5–7	Asphalt & Port. Cem. Concrete	No		Yes	Lack of drainage and improperly prepared subgrade
Ohio:							
Marysville	Clay, gravel	8	Brick	Yes	Autos and trucks	Yes	
Sidney	Concrete	6	Brick			Yes	Settlement of new embankment
South Point	Macadam	6	Macadam	Yes	225 ¼ ton to 10 ton		
Oklahoma:							
Lawton	Asphalt	6		Yes		Yes	
Pennsylvania:							
Bradford	Gravel and concrete	6	Brick			Yes	Pipe trenches—settlement of embankment
Hanover	Concrete	6	Brick			Yes	Pipe trench
Jersey Shore	Concrete	6	Brick	No		Yes	Pipe trenches—lack of drainage
Philadelphia	Macadam	4–6	Bitulithic	Yes	1,000 to 3,00 vehicles	Yes	Soil and drainage unfavorable
Pittsburgh	Concrete	6	Sheet asphalt	Yes	Truck traffic	Yes	Clay sub-soil
Woodlawn	Concrete	5	Brick block	No		Yes	Settlement of embankment

BASE AND SUB-BASE FAILURES Continued

City and state	Failure Kind of base	Failure Thickness	Wearing surface	Failure due to traffic	Kind of traffic	Failure due to yielding subsoil	Probable cause of yielding
South Carolina:							
Spartanburg	Macadam	4	Bitulithic	Yes	1 to 5 ton trucks		Poor foundation
South Dakota:							
Aberdeen	Concrete	6	Wood block	No		Yes	
Texas:							
Amarillo	Vibrolithic	7	Vit. concrete	No		No	Lack of sufficient expansion joints
Bonham	Crushed stone	4	Gravel			No	Not kept in repair
Washington:							
Dayton	A. C.	4	Bitulithic	No		Yes	Pipe trench
W. Virginia:							
Clarksburg	Stone	8	Brick	Yes	5-ton trucks	Yes	Poor drainage
Moundsville	Concrete	4—6	Brick				Installing sewer system
Wisconsin:							
West Allis	Concrete	6	Concrete, asphalt, creosote blocks	Yes	Heavy trucks	Yes	Lack of drainage over pipe trenches
Kansas:							
Emporia	Concrete	4-5	Brick & asphaltic concr.	No		Yes	Yielding of sub-soil and expansion of concrete.
Topeka	Concrete	5	2-in. asphalt	Possibly	Heavy trucks	Possibly	Base failed for some distance beyond ditch lines.
Massachusetts:							
Springfield	Cement concr.	6	Wood blocks	No		Yes	Drainage
New Jersey:							
Bound Brook	Macadam	6	Tar macadam	No		Yes	Pipe trenches—house connections.
Summit	Broken stone	5	Brick	Partly		Doubtful	Poorly constructed; street dug up for repairs to leaky sewer force main.
New York:							
Queens, N.Y.C.	Macadam	6-12	Asphaltic conc.			Yes	Frost
Pennsylvania:							
Butler	Concr. & slag	6c-9s	Brick block			Yes	Pipe trenches and poor drainage.
Greensburg	Slag & stone	6	Vit. paving block	Partly	5-10 ton motor trucks	Partly	Lack of drainage and winter springs.
Williamsport	Concrete	6	Brick	No			Leaky water mains.
Rhode Island:							
Warwick	Gravel	6	Macadam, tar-via treated	No		Yes	Lack of proper drainage.
Texas:							
Houston	Concrete	5-6	Brick, asphalt & wood block	No		Yes	Due to black, waxy soil, which when dry, cracks open; when rain comes cracks are filled causing settlements in some places and heaving in others
Washington:							
Aberdeen	Concrete	4-5-6	Sheet asphalt	..	Up to 7 tons; 500 a day	Partly	Unequal settlement of embankment — insufficient foundation; poor concrete.
Wisconsin:							
Kenosha	Concrete	5	Brick & asphalt	No		No	Sewer trenches — gas and water trenches.
Wyoming:							
Casper	Concrete	4-5	2-in.	No		Yes	Pipe trench

Pavements Laid During 1920

Quantities are square yards or miles unless otherwise indicated.

City and State	Sheet Asphalt	Asphalt Concrete	Tar Concrete	Warrenite-Bitulithic	Bitoslag	Rock Asphalt	Willite	Asphalt Macadam	Tar Macadam
Alabama:									
Florence	.....	.....	.....	78,571.05	.....	.....	.....	.....	.....
California:									
Alameda	.....	.....	.....	.....	.....	.....	.....	1,000	.....
Los Angeles	136,055	5,510	.....	51,721	.....	.....	.....	.....	.....
South Pasadena	.....	.....	.....	.....	.....	.....	.....	25,180	.....
Connecticut:									
Hamden	.....	.....	.....	.....	.....	.....	.....	6,733	.....
Iowa:									
Oskaloosa	.....	3,291	.....	.....	.....	.....	.....	.....	.....
Kansas:									
Topeka	.....	2,400	.....	.....	.....	.....	.....	.....	.....
Kentucky:									
Middlesboro	.....	.....	.....	.....	.....	3,086	.....	.....	.....
Maine:									
South Portland	.....	.....	.....	.....	.....	.....	.....	.....	¼
Massachusetts:									
Greenfield	.....	.....	.....	.....	.....	.....	.....	2,500	.....
Peabody	.....	.....	.....	.....	.....	.....	.....	6,000	.....
Springfield	21,500	.....	.....	.....	.....	.....	.....	42,000	51,600
New Jersey:									
Summit	.....	.....	.....	.....	.....	.....	.....	.....	8,400
New York:									
Queens, N.Y.C.	100,000	250,000	.....	.....	.....	.....	.....	200,000	.....
Poughkeepsie	.....	.....	.....	.....	.....	.....	.....	1,028	.....
Oregon:									
Ashland	.....	.....	.....	9,000	.....	.....	.....	.....	.....

PAVEMENTS LAID DURING 1920 Continued

City and State	Sheet Asphalt	Asphaltic Concrete	Bit. Concrete	Wood Block	Brick	Granite	Sq. Yds.	Miles	Total Miles
Rhode Island:									
Warwick									
Texas:									
Houston									
Wisconsin:									
Kenosha	31,821								
Wyoming:									
Casper									

Cities and States	Amiesite	Granite other than Block	Block or Clay Block	Creosoted Wood Block	Concrete Reinforced	Concrete Not Reinforced	Penetration Macadam	Gravel	Concrete
California:									
Alameda									
Los Angeles									
Monrovia									
Ontario									
South Pasadena									
Iowa:									
Atlantic									
Kansas:									
Emporia									
Topeka									
Maine:									
South Portland									
Massachusetts:									
Greenfield									
Peabody									
Springfield									
Missouri:									
Boonville									
Nevada									
New Jersey:									
Bound Brook									
Summit									
New York:									
Queens, N.Y.C.									
Poughkeepsie									
Ohio:									
Middletown									
Pennsylvania:									
Butler									
Somerset									
Warren									
Rhode Island:									
Warwick									
Texas:									
Houston									
Utah:									
Logan									
Virginia:									
Fredericksburg									
Washington:									
Aberdeen									
Wisconsin:									
Kenosha									
Wausau									
Wyoming:									
Casper									

s—Sq. ft. $ $—Ft. b—Lineal feet

Labor Conditions

City and state	Will there be enough labor for 1921?	Present price	No. of hrs. per day	What will it be next spring?
Alabama:				
Florence	Yes	$3.00	8	$2.00-$2.25
California:				
Alameda	Yes	5.00	8	4.50
Los Angeles	Yes	4.50	8	4.00
Monrovia	Yes	4.00	8	3.00-3.50
Ontario	Yes	3.20	8	3.20
Pomona	Yes	2.50-3.50	8-9	same
So. Pasadena	Yes	3.50	8	same
Connecticut:				
Hamden	Yes	4.00	10	3.50
Illinois:				
Rochelle	Yes	4.00	10	same
Iowa:				
Algona	Yes	6.00	10	5.00
Atlantic	Yes	5.00	10	.40
Glenwood	Yes	.50	..	.40
Monticello	Yes	4.00-5.00	10	....
Oskaloosa	Yes	.45	..	....
Kansas:				
Emporia	....	3.60	8	same
Topeka	Yes	3.20-3.60	8	.40
Kentucky:				
Frankfort	Yes	2.50-3.00	10	same
Madisonville	Yes	3.00	9	2.00-2.50
Middlesboro	Yes	3.00	8	lower
Maine:				
South Portland	Yes	4.00	9	same
Massachusetts:				
Greenfield	Yes	3.20	8	higher
Peabody	Yes	5.20	8	less
Springfield	Yes	4.64	8	less

LABOR CONDITIONS Continued

City and state	Will there be enough labor for 1921?	Present price	No. of hrs. per day	What will it be next spring?
Minnesota:				
Moorhead	Yes	....	..	....
Missouri:				
Boonville	Yes	.25	10	same
Nevada	..	3.50	8	same
New Jersey:				
Bound Brook	Yes	3.60	9	same or less
Summit	Yes	4.50	8	4.00
New York:				
Poughkeepsie	Yes	4.00	8	2.50-3.50
Ohio:				
Middletown	Yes	.35-.40	10	same
Oregon:				
Ashland	..	4.00	8	4.00
Bend	Yes	5.25-5.50	8	4.50-5.00
Pennsylvania:				
Butler	Yes	3.60	9	2.70-3.15
Greensburg	Yes	4.50	9	....
Shippensburg	Yes	.15-.45	10	.30
Somerset	Yes	3.50-4.00	9	3.00
Warren	....	4.00	8	....
Williamsport	Yes	4.00-4.50	10	3.00-3.50
Rhode Island:				
Warwick	Yes	4.50	9	3.15
Texas:				
Houston	Yes	.35-.50	8	same
McKinney	Yes	3.00	8	2.50
Utah:				
Logan	Yes	3.50-4.00	8	same
Virginia:				
Fredericksburg	....	3.00	9	2.50-2.75
Washington:				
Aberdeen	Yes	6.00	8	4.50
Wisconsin:				
Kenosha	Yes	4.00	8	4.00
Wausau	Yes	4.00	8	....
Wyoming:				
Casper	....	6.00	10	5.50

NEWS OF THE SOCIETIES

Apr. 4—OHIO STATE ASSOCIATION, AMERICAN INSTITUTE OF ARCHITECTS, Columbus, Ohio.

Apr. 5-6—SOUTHERN PINE ASSOCIATION. Sixth annual meeting. Grunewald Hotel, New Orleans, La.

April 11 — HARTFORD SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. City Club, Hartford, Conn.

Apr. 13—ASPHALT ASSOCIATION. New York City.

April 14—SAN FRANCISCO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

April 15 — MERIDEN SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

April 16—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Joint meeting with the Association of Iron and Steel Electrical Engineers. Pittsburgh, Pa.

April 18-23 — UNITED STATES GOOD ROADS ASSOCIATION. Greensboro, N. C.

April 21-22—BANKHEAD NATIONAL HIGHWAY ASSOCIATION. 5th annual convention. Greensboro, N. C. Secretary, J. A. Routree, Birmingham, Ala.

April 22 — METROPOLITAN SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with American Institute of Electrical Engineers.

April 22—BIRMINGHAM SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with Atlanta, Birmingham and New Orleans sections, with members of Council present. Battle House, Mobile, Ala.

April 27—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention. Houston, Texas.

Apr. 27-29—BUILDING OFFICIALS CONFERENCE. Cleveland, Ohio.

Apr. 27-29—SOCIETY OF INDUSTRIAL ENGINEERS. Milwaukee, Wis.

April 27-29—UNITED STATES CHAMBER OF COMMERCE. 9th annual meeting. Atlantic City, N. J.

April 27-29 — BUILDING OFFICIAL'S CONFERENCE. Seventh annual meeting. Cleveland, Ohio.

April 28-29—MID-CONTINENT SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting of Chemical Eng. Societies. City Auditorium or Convention Hall, Tulsa, Okla.

April 29 — EASTERN NEW YORK SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Edison Club Hall, Schenectady.

April 29 — COLORADO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Metropole Hotel.

May 2-4—MISSISSIPPI VALLEY ASSOCIATION. 3d annual convention. New Orleans, La.

May 4-7—NATIONAL FOREIGN TRADE CONVENTION. 8th convention. Cleveland, Ohio.

May 9-11—AMERICAN ASSOCIATION OF ENGINEERS. 7th annual convention. Buffalo

May 9-12—SOUTHWEST WATER WORKS ASSOCIATION. Shirvin Hotel Headquarters, Oklahoma City, Okla.

May 17-19—NATIONAL FIREMEN'S ASSOCIATION. Twenty-third annual convention. Fort Wayne, Ind.

May 19 — SAN FRANCISCO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

May 20 — AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. 370th meeting. Engineering Societies Building, New York City.

May 23-26 — AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Spring meeting. Congress Hotel, Chicago.

June—CONFERENCE OF MAYORS AND OTHER CITY OFFICIALS, State of N. Y. 12th Annual Conference. Elmira, N. Y.

June 6-10—AMERICAN WATER WORKS ASSOCIATION. Annual convention at Cleveland, Ohio. Secretary, J. M. Diven, 153 West 71st St., New York.

June 7-9—NATIONAL FIRE PROTECTION ASSOCIATION. Annual meeting. San Francisco, Cal.

June 21-24 — AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual and Pacific Coast Convention. Salt Lake City.

AMERICAN ASSOCIATION OF ENGINEERS

The records of the Employment Service Bureau of the American Association of Engineers show that approximately 10 per cent of the engineers in the country are out of employment at the present time. The greatest demand for engineers is in municipal and highway work; there is little demand for railroad engineers, and indications are that no improvement can be expected before August.

The average monthly salary of positions filled during February was $195; total salary of all positions filled was $55,000; saving to members if commercial agencies rendered this service was $33,000.

With a membership of 25,000 engineers of varied qualifications, the American Association of Engineers provides a national agency of engineers for engineers to aid members of the association without cost to them.

BROOKLYN ENGINEERS' CLUB

At the informal meeting March 24, "The Soaring of Birds" was described by Carl Monniche, civil engineer. Mr. Monniche claimed to have discovered how a soaring bird is able to get kinetic as well as potential energy from a horizontal wind with no physical effort, apparently defying all known laws of gravitation. He also explained how, according to his studies, nature has developed soaring birds to facilitate this.

At the informal meeting March 31, Edward P. Atkinson, engineering expert of the Charles A. Schieren Co., presented Industrial Brooklyn Paper No. 5, in which he described and illustrated with moving pictures the process of manufacture of leather belting from the raw hide to the finished product.

THE ENGINEERS' CLUB OF PHILADELPHIA

On March 29 the Engineers' Club held a meeting at which various problems incident to city paving were discussed. The papers presented at this meeting will be published in the Journal of the club.

INDIANAPOLIS CHAPTER, AMERICAN ASSOCIATION OF ENGINEERS

The March 1 meeting of the Indianapolis chapter, A. A. E., for which special invitations were extended to the Scientech Club, the Indianapolis Architects' Association, the Indianapolis Building Contractors and the Indianapolis section, A. W. M. E., was addressed by Lieut.-Col. Boyden, of the Portland Cement Association. His subject was "Recent Developments in Concrete."

The monthly meeting on March 3 was held at the Chamber of Commerce, with Vice-President Ratcliff in the chair. Old resolutions, such as the construction industry, ballot headings, etc., were taken up—and the Indiana Highway Commission and the principles declared by the American Federation of Labor at its recent conference were fully discussed.

INDIANA SANITARY AND WATER SUPPLY ASSOCIATION

The two-day convention of this association, held in Indianapolis on Feb. 16 and 17 was a strictly technical one. The matters of superintendence, extensions and payment for service connections were especially considered. Other subjects discussed were water purification of pollution conditions in the Calumet region, and city planning and its relation to utilities and housing development.

The following officers were elected for the coming year: President, Charles Brossmann; vice-presidents, J. B. Marvin, H. E. Jordan, John C. Davis, George L. Smith and L. Elliott; secretary, C. K. Calvert; assistant secretary, Charles J. Miller.

SAN FRANCISCO SECTION, AMERICAN SOCIETY OF CIVIL ENGINEERS

The bi-monthly meeting of the San Francisco section of the A. S. C. E., held on February 15, was devoted to a discussion of land improvement work in the central California flood basins. The following papers were read: "Development Under Way and Projected," by Fred H. Tibbetts; "Construction and Operation of World Record Dredges," by F. S. Cooper; and "Installation of Large Drainage Pumps," by Robert Shurman.

AMERICAN RAILWAY ENGINEERING SOCIETY

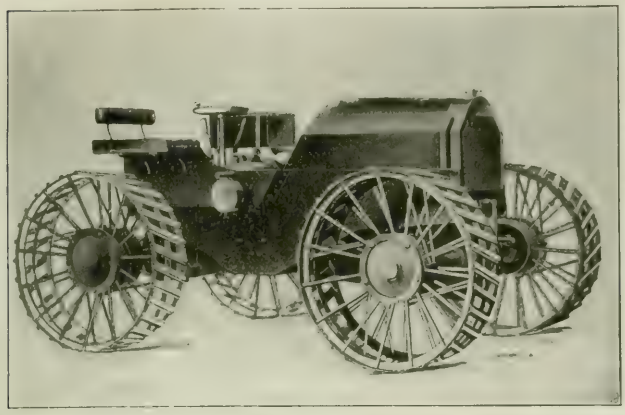
All records for attendance at American Railway Engineering Association meetings were broken on March 15-17, when the annual meeting was held in Chicago. The officers elected at this time for the ensuing year are: President, L. A. Downs; vice-president, E. H. Lee; treasurer, G. H. Bremmer; secretary, E. H. Fritch; and new directors, C. F. W. Felt, G. J. Ray and Col. G. H. Webb. The new nominating committee is as follows: J. R. W. Ambrose, R. H. Ford, E. A. Hadley, J. V. Neubert and A. F. Robinson.

MINNESOTA FEDERATION OF ARCHITECTURAL AND ENGINEERING SOCIETIES

The Minnesota Federation of Architectural and Engineering Societies organized at a meeting in St. Paul on March 11, presided over by Adolph F. Meyer, president of the Minnesota Joint Engineering Board. The federation consists of ten societies and branches of national organizations, which had previously ratified the constitution of the federation. It has no individual members, membership being vested in the various societies, each of which pays dues according to the number of its members.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



TRACTOR WITH POWER APPLIED DIRECTLY TO ALL FOUR WHEELS

NELSON FOUR-WHEEL DRIVE TRACTOR

The 4-wheel drive tractor manufactured by the Nelson Corporation and sold by the Macbee Company is a powerful, reliable, all-around machine that can be driven through snow, mud or sand, and over large rocks and stumps, across ditches and up steep hills, or over smooth pavements without injuring the latter. It is built in three models, differing only in size, and claims special excellence on account of the application of power to all four wheels, stearing by both front and rear wheels simultaneously honeycomb two-core radiator, unit assembly, three-point suspension and patent link chain drive so flexible that under all conditions the engine power is transmitted to the drive wheels uniformly whether one or all of them are on the ground and whether they are in line or at angles.

The tractors have speed of 1½ to 4 miles per hour and a reverse speed of 2½ miles per hour. The weight is almost equally distributed on both axles, and the draw bar pull shows 75 per cent power efficiency.

PUMP GOVERNOR BULLETIN

Having acquired sole rights to manufacture and sell the "Ideal" pump governor, the Atlas Valve Company is now distributing Bulletin No. 1-A, Edition No. 1, describing it.

The Bulletin shows photographs of finished pump governors, and cross-sectional drawings with all parts numbered, installation and operation are fully explained.

It describes the "Ideal" pump governor for turbine or reciprocating steam-driven pumps; for marine or stationary turbines; fire pumps, lubricating oil pumps, bilge pumps, fuel oil pumps, a pump governor equipped with an emergency control lever for saturated or superheated steam, a governor which automatically shuts down the pump in case of accident to the pump discharge line; a relief valve for oil pumps accepted by the United States Navy for use on Navy vessels suitable for light or heavy oil under high or low pressure; and a high-pressure hydraulic regulating valve suitable for pressures from 500 to 1,000 pounds per square inch. This governor is approved by the National Board of Supervising Inspectors of Steam Vessels, and it is also approved by the Bureau of Engineering, United States Navy Department. Two pages of the bulletin are devoted to special types of Ideal governors for accumulators, for high-pressure fire hydrant service to reduce the main pressure to a safe carrying hose pressure, for hydraulic pumping rams, and for pumps for low-pressure salt or fresh water, acids, oils, ammonia, gas or air-line service.

THE AUTO-SWEEPER

The Auto-sweeper is described in circular 44 published by the Elgin Sales Corporation, which recommends motor sweepers for efficiency and for the relief of street congestion by virtue of its operation with the least possible interference with traffic. The machine occupies a 65 x 164-inch space and has an 8-foot broom. It is mounted on three wheels so as to turn in narrow streets without backing. The parts of the machine are made adjustable and it is provided with an air compressor and valve regulation to adjust the quantity and pressure of water for sprinkling, which can be reduced to 180 gallons per hour under the best conditions. The water can be regulated from a fine mist to a heavy spray and is strained at the sprinkler nozzles, which can be cleaned in 15 seconds. The machine is provided with an extra broom to be used while the fibre in the other is being replaced. The broom can be set at a right or a left angle, is adjustable, and is suspended from springs.

The engine is of 35 h. p. with a 5-inch stroke and consumes from 6 to 8 gallons of gasoline and 2 quarts of oil daily. The machine has three speeds forward and one reverse, and can be operated at a speed of 8 miles per hour, thus covering 262,826 square yards of pavement in 8 hours.

GRUENDLER STONE CRUSHER

The Gruendler Patent Crusher and Pulverizer Company has put on the market the Gruendler good road builder which is a complete plant comprising a crusher, elevator, screen and bin which, although mounted on portable trucks for its transfer along the highway, is as strong as any stationary outfit, and can be separated into independent crusher and elevator installations.

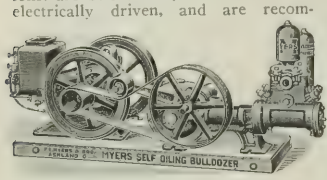
The crusher has a fixed and a movable jaw set with an adjustable distance between them governed by toggle plates and wedges of several sizes to regulate the size of the crushed stone. The portable machine is built in 7 x 10, 8 x 12, 9 x 14, 10 x 16 and 12 x 20-inch sizes, with or without a folding elevator and a gasoline or kerosene engine. The approximate weight varies from 2,500

35 H.P. MOTOR SWEEPER WITH CAPACITY FOR MORE THAN 262,000 SQUARE YARDS IN 8 HOURS

pounds to 11,000 pounds and the capacity runs from about 1 ton to 20 tons per hour of ¼-inch to 3-inch products. The company also manufactures cylindrical and conical revolving and shaker screens and a special friction clutch pulley for use when the crusher is driven by a gasoline tractor or engine which can be freely started before engaging the crusher.

SELF-OILING BULLDOZER POWER PUMPS

The self-oiling Bulldozer power pumps manufactured by F. E. Myers & Brother are made in seven sizes with capacities from 500 gallons to 4,500 gallons, are belt driven, motor driven or electrically driven, and are recommended for general contractors' purposes, for road building and for other portable power work.



SELF-OILING PUMP FOR HIGHWAY CONSTRUCTION

They will deliver water at a distance of 2½ miles against an elevation of 450 feet. They are self-oiling with all working parts fully enclosed and can operate at high speed with minimum attention.

PERSONALS

Hogg, W. T., formerly with the engineering department of the Dock Board at New Orleans, La., has been appointed chief draftsman.

Wilson, Capt. W. J., has been appointed assistant chief engineer in the engineering department, Port Commission, Seattle, Wash., and George F. Nicholson is chief engineer.

Murdock, Alexander, chief adjuster, U. S. Emergency Fleet Corporation, has been appointed city engineer of Chicago.

Sneary, Roy E., formerly assistant engineer of Davenport, Ia., has been appointed city engineer of East Moline, Ill.

Shea, William J., formerly Major of Engineers, U. S. A., has been appointed construction engineer, Department of Public Works, Bureau of Highways, Brooklyn, N. Y.

Greene, Col. Frederick Stuart, formerly New York State Highway Commissioner, has opened an office in New York City as consulting engineer on highway construction and department organization, waterproofing, pier, dock and concrete construction.

F. F. Censky has been promoted to assistant advertising manager of the Traffic Motor Truck Corporation, St. Louis.

Waugh, Richard D., formerly chairman of the Greater Winnipeg Water Board, was reappointed by the executive council of the League of Nations as Canadian member of the Saar Valley Governing Commission.

Washington, Walter, has been appointed city manager of Charlottesville, Va., to succeed Shelton S. Fife.

Dugan, F. C., formerly design engineer, sewerage division, Flint, Mich., has been appointed state sanitary engineer of Kentucky, with headquarters at Louisville.

McKenzie, Major-Gen. Alexander, U. S. A., retired, died on February 23, at Washington, D. C.

McDonough, Col. Michael J., Corps of Engineers, U. S. Army, died in Denver, Colo., on February 13.

Inman, C. E., now manager of the municipal plant of Paterson, N. J., will be manager of the water department of Warren, Ohio, after April 1.

Anderson, Carl, has been appointed superintendent of the water works of Mitchell, S. D.

Comant, Nelson Whitney, secretary of the Jersey City N. J., Water Supply Co., died in New York on March 1, at the age of seventy-two years.

Wolf, Herman C., formerly assistant engineer of the Illinois Public Utility Commission, has been appointed assistant chief engineer of the Public Service Commission of Maryland.

Fitch, Squire E., has been appointed a division engineer of the New York State Highway Department.

Kintz, M. L., has been appointed city building commissioner of Canton, Ohio.

Dugan, F. C., formerly designing engineer of the sewerage division office of the city engineer, Flint, Mich., has been appointed state sanitary engineer of Kentucky with headquarters in Louisville, Ky.

Cranch, Eugene T., has been appointed city sanitary engineer of Petersburg, Va.

Ripley, Theron M., is now division engineer of the New York State Highway Department and will have charge of the division office at Hornell, N. Y., and Perry Filkin, formerly division engineer there, has been transferred to the Buffalo division.

Lederle, Ernst J., chemist and twice commissioner of health of New York City, died on March 7.

INDUSTRIAL NOTES

A new branch of the Blaw-Knox organization, to be known as the development department, has been created with O. D. McArthur, formerly assistant general sales manager, in charge. Mr. McArthur will direct the development of new products, both for manufacture and sale.

N. B. Payne & Co., of New York, dealers in electric cranes and hoists, are now handling machinery to include the portable conveyors of the A. C. Warner Co., Philadelphia, Chicago automatic coal elevators and McKinney-Harring ton package pilers and car loaders.

The Chippewa Pump Co., Chippewa Falls, Wis., has opened an office at 201 East Ontario street, Chicago, Ill., with J. C. Huffman as district manager.

The Western Tool & Manufacturing Co., of Springfield, Ohio, has established an office at 25 Park place, New York City.

The Adamson Manufacturing Company, East Palestine, Ohio, has added a new department for manufacturing all kinds of storage, pneumatic and pressure tanks, welded pipe, battery casings, evaporators, condensers, etc.

The National Steel Fabric Co. of Pittsburgh, Pa., has opened an office in the Mutual building, Kansas City, Mo., in charge of H. H. Robinson.

The Equitable Equipment Co. has taken over the equipment, rail and machinery business of A. Marx & Sons, the Southern Scrap Material Co. and the Ship Supply Co. and will handle this under its new organization which is to be managed by Mr. Cleveland, formerly manager of the New Orleans branch of the General Equipment Co. The office will be at 411 Whitney-Central building, New Orleans, La.

BIG ROOFING CONCERN CHANGES ITS NAME

The Standard Paint Company, manufacturers of Ruberoid Roofing for nearly forty years, will be known, after April 1, 1921, as The Ruberoid Co.

This change of name will in no way affect the products nor the personnel of this concern. The offices and plants of The Ruberoid Co. will be the ones now operated by The Standard Paint Company.

AUSTIN MACHINERY CORPORATION

The extensive fire in the Winthrop Harbor, Ill., plant of the Austin Machinery Corporation on Tuesday night, March 22, will not in any way interfere with production and prompt delivery of Austin trenching machines, backfillers, building mixers, pavers, draglines and shovels, as practically all lines of Austin machinery are also being built at the plants at Muskegon, Mich., as well as at the former plant of the Toledo Bridge & Crane Co., at Toledo, Ohio.

The fire at the Winthrop Harbor plant completely destroyed the "unfinished stock" warehouses and store rooms; both the trenching machinery assembly and paving mixer assembly buildings, and a number of machines on which assembly was practically completed; but the fire did not reach the "finished machines" warehouses.

The Austin Machinery Corporation has on hand in Muskegon and at Toledo ample stocks of wagon loaders, the popular sizes of trenching machines, backfillers, mixers, pavers and ½-yard and ¾-yard draglines and shovels and a new lot of 1-yard shovels and draglines are now coming through the Toledo plant.

NEW BLAW-KNOX OFFICE

The Blaw-Knox Company, of Blawnox, Pittsburgh, will, on April 1, open a new sales territory in the Southwest, with headquarters in Kansas City, Mo. In addition, the Blaw-Knox Company has sales offices in New York, Chicago, Detroit, Boston, Baltimore, San Francisco and Sheffield, Eng.

The Kansas City office is in charge of R. B. Randall, who will be known as manager of the Southwestern territory.

PUBLIC WORKS.

CITY **COUNTY** **STATE**

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Municipal Journal and Engineer, Inc.

Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.

Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879

Vol. 50 **APRIL 16, 1921** **No. 16**

Short Span Highway Bridges

Urban, suburban and rural, Concrete, steel, wood and combination structures. Location, requirements, design, financing, construction and maintenance. Superstructures, substructures and architectural effect.

Long-span and lofty highway bridges are comparatively infrequent and are so costly that their design always warrants expert engineering and heavy outlay and generally requires construction that makes each bridge a special problem. They will therefore be excluded from present consideration, which will be limited to the vastly greater number of short-span bridges for vehicular, pedestrian and electric car service in city, town or country. These interest all state, county and municipal officials, are a vital factor in highway construction and maintenance, and involve an aggregate annual expenditure for construction, repairs and maintenance that is far in excess of that required for the long-span bridges.

PRIMARY CONSIDERATIONS

What type of bridge is best suited for a given case is dependent on whether it is to provide for urban, suburban or rural traffic, on existing traffic conditions, on length and height of span, on the character of foundations, on the location, and to some extent on commercial and labor conditions.

The widest, strongest, and therefore generally the most costly structures are imperative for urban traffic where there is likely to be little or no choice of location or elevation. In rural districts the bridges generally may and should be much lighter and cheaper, with few limitations of type or exact dimensions and often subject to considerable choice of position, thus giving a large freedom of design and proportionate opportunity for economy of construction. The corresponding features of suburban bridges are naturally intermediate between those of the urban and rural structures. Bridges on trunk lines and state highways, even though remote from towns, cannot be classified as rural structures, and must in general conform to many of the requirements for urban structures.

Urban and suburban bridges, those in parks and on boulevards and scenic highways, and all bridges in conspicuous positions (excepting possibly those in localities permanently devoted entirely to industrial and mechanical interests, such as those crossing railroad yards and heavy manufacturing districts) should be designed and con-

MARKET STREET BRIDGE OVER TENNESSEE RIVER AT CHATTANOOGA.
Steel bascule spans 300 feet long, multi center concrete arch spans 165 and 180 feet long. Cost of superstructure $426,520, substructure $580,605. Completed December, 1917. B. H. Davis, Engineer.

structed with ample consideration for artistic and architectural effects; to harmonize with the surroundings, and to be consistent with the present conditions and future development of the locality, which they can often be made to adorn instead of disfigure. A bridge can sometimes be made monumental at little or no greater expense than is involved in building the most rigidly economical structure. These features are secured by proper attention to location, type, proportions, and details which, so far as possible, should be determined in conference with or be approved by competent specialists and critics.

LOCATION

In cities and towns the location of a bridge is usually rigidly predetermined and can be varied only slightly, often at a heavy expense. In such structures there is therefore generally little choice in the length or position of the spans and not much in their elevation. In suburban districts there is likely to be some choice of position within given limits, often enough to materially modify the cost and design. For rural bridges there are much greater opportunities for freedom of location, which should be carefully exercised to secure the most advantageous sites, even sometimes at the expense of shifting the approaches to secure improved grade or alignment, better foundations, or shorter bridges, or to avoid dangers to or obstruction of navigation, or the condemnation of costly property.

In all cases the govening considerations should be safety, efficiency, ultimate economy, durability, and beauty. Rivers, especially those with much current, should be crossed at right angles and at sufficient heights for the superstructures to clear all possibility of flood and floating debris as well as to give necessary provision for navigation if there is any. Streets, highways, railroad tracks and canals should be crossed at right angles when convenient and with abundant vertical and horizontal clearance for all kinds of traffic under the bridge. In crossing over railroad tracks, recognition must be made of the possibility of wrecks on the railroad and the bridge should not be liable to destruction through their occurrence.

If the bridges are over navigable streams or harbors, consideration should be given to the possibility of future requirements for movable spans to permit shipping to pass and for the possibility of deepening the channel by dredging operations that may endanger foundations. The elevation of the floor should be kept as low as possible to avoid obstruction of and danger to highway traffic through heavy approach grades and the great cost of surmounting them by the traffic. Where there is a choice of location, care should be taken to secure a short structure with good foundations and on cheap land. The local requirements encountered are more likely to be easily complied with for new construction than for replacing old structures.

Where the structure connects low ground at either or both ends, it may often be advisable to supplement the bridge proper with a causeway, solid embankment, or earth fill between retaining walls, at one or both ends, thus materially reducing the length of the bridge and number of spans.

In replacing an existing bridge it is usually necessary to provide for traffic during construction. This sometimes involves building an entirely new temporary structure if the new spans are built exactly in the position of the old ones, or it may be that the old structure can be removed piecemeal while the new one is being erected in the same position and traffic maintained, or that the old structure may be removed and the new one built in successive longitudinal halves so that one half of either old or new structure is open to traffic while the other half is not. These considerations may sometimes make it desirable to deviate slightly from the old alignment and build the new structure close alongside the old one, retaining the latter in service until the new bridge is ready to receive traffic, after which the old one can be removed at leisure with a minimum of expense and interruption. Steel spans can sometimes be built complete at a nearby or remote position and rapidly moved to place over night or in a few hours while the old structure is being demolished or removed so that no temporary provision for traffic is required. Such operations are occasionally desirable for the safe construction of bridges over railroad tracks, particularly in freight yards and near terminals or over several main line tracks.

MONT CLARE BRIDGE OVER SCHUYLKILL RIVER, PHOENIXVILLE, PA.
Concrete arches, 193 feet span. Completed April, 1927. Superstructure cost $[illegible], substructure $[illegible]. Rise 31 feet 6 inches.

Height and Capacity of Bridges

Whatever the height or length of a bridge, its capacity depends on the width of roadway and the strength of span, which must be determined in accordance with traffic requirements. Broadly speaking, these vary according to the general classifications of urban, suburban and rural, but the character of the region, local condition, future probabilities and the type of roadway to be supported are of great importance, involving large variation in the service that the bridge is required to meet and therefore in its capacity and dimensions.

It is manifestly impossible to establish exact, arbitrary rules to govern any of these cases, but it is possible to follow standard practice and employ approved design and at the same time make adequate provision for strength and loading within certain limits. General requirements of strength, quality and workmanship should be written in the specifications, but these should be modified and details carefully determined by capable specialists whose function is to make the most advantageous selections or designs and to see that they are economically and reliably executed with justice both to the purchaser and the builder.

For cities and large towns the bridges should, if possible, be the full width of the street, of sufficient strength to carry any traffic or special loading that may travel the street, should carry the pavement continuously across the structure and, when practicable, the structures, excepting protecting parapets, should be built entirely below road level. They should be proportioned for the heaviest concentrated team loads, for the transportation of heavy machinery or equipment, and for the entire floor surface to be covered with vehicles or solid crowds of pedestrians, with ample provisions for wind strain, impact, vibration, irregularity and deterioration. The style should be plain, dignified or even severe.

Suburban bridges may be narrower and, according to their proximity to great cities, heavy manufacturing centers or industrial highways may provide for the same or decreased loadings required for city bridges. Especial care should be taken to design them so that their type may be harmonious with the local surroundings, general landscape and future improvements.

Practically the same considerations apply to bridges on boulevards and hard state highways and trunk lines, except that in some cases no provision may be necessary for future electric car service and in other cases statutory restrictions of traffic on the roadway may exclude heavy trucking, which therefore need not be provided for. On the other hand, they may serve very rapid or congested pleasure or tourist traffic requiring wide roadways and provision for higher speed than is permissible within city limits. Both of them are factors that influence the type and details developed.

In strictly rural localities much greater latitude is permissible than elsewhere, and under some conditions the width and capacity of the structure may be much less than in city and suburban localities. They should always, however, be wide enough to give clearance for, and strong enough to carry, two heavy automobile trucks or a full load of moderate weight automobiles going in the same direction at moderate speed. In all localities, spans of 50 feet or less should be proportioned to have their floor surface entirely covered with heavy, fast moving vehicles.

In all cases the floor itself should be proportioned throughout for maximum loads and impact, and the roadway should be thoroughly protected by substantial barriers on both sides that will prevent the possibility of vehicles leaving the bridge except at the ends. The bridge floor should be crowned slightly toward the center of the span or group of spans, or should be level, or on the lowest possible uniform grade, and the utmost efforts should be taken to avoid a descending grade on the approach toward either end of the bridge, as such is likely to cause dangerous impact on the bridge floor.

PENN STREET BRIDGE OVER SCHUYLKILL RIVER, READING, PA.
Five 111-foot and nine 48-foot concrete arch spans. Completed November, 1913. Cost $437,470. B. H. Davis, engineer.

SUB-STRUCTURE

The design and location of the sub-structure (piers and abutments) is inseparable from that of the superstructure (the connecting spans), inasmuch as the distance between supports is a vital factor of the cost of the superstructure and the safety and durability of the structure is primarily dependent on that of the sub-structure. However, the type and method of construction of the sub-structure may be almost or quite independent of the superstructure. It has long been accepted almost as axiomatic that the most economical bridge is, roughly speaking, one in which the cost of the superstructure is about equal to that of the sub-structure, so that the higher the span and the more difficult the foundations the greater should be the distance between the piers; and conversely, for bridges with a comparatively low elevation where the water is shallow and the foundations are good, the spans should be made very short. These conditions are obviously influenced by circumstances of flow, navigation and railroad traffic and other special features that may exist under the bridge.

28-FOOT GIRDER SPAN, 24-FOOT ROADWAY

It should, however, be remembered that, other things being equal, the cost of spans increases approximately with the square of their length and that the cost of river foundations increases rapidly with the depth of the water. Also that the cost of the superstructure can be closely predetermined while that of the sub-structure is often very uncertain and may involve very large unexpected items and operations of a slow and dangerous character that are not foreseen in advance.

When, therefore, it is a matter of choice and conditions are uncertain, it is safest to reduce the number of foundations at some addition to the minimum cost of the bridge. This is especially true in regard to bridges over streams where the obstruction of the flow by channel piers may produce changed conditions that will impound the water, flood adjacent territory, scour the river bed or obstruct the channel so as to cause accumulation of drift and ice and in various ways produce serious damage.

EXPLORATIONS AND METHODS

Unless there is available complete, reliable knowledge of the river bottom, the expenditure of considerable time and money for careful exploration, surveys and soundings and sometimes tests by experienced specialists is well justified and determination of the character and location of piers and abutments should be based on such information. The most desirable sub-structures are solid concrete or stone masonry carried down to bed rock or hard stratum. If this is impracticable, they may be supported on pile footings or may have their bases extended so as to reduce the unit pressure and prevent settlement. In all cases they should be carried below the possibility of displacement or interference by flood or other disturbances or should be completely protected against them. Excavation to a depth of 5 or 6 feet below water level can easily be made in the dry by simple cofferdams kept dry by pumping. Unless the bottom is very irregular rock and boulders or quicksand, the same can usually be done up to a depth of 15 or 20 feet or in some cases to an even greater depth by the use of more costly cofferdams and pumping, thus enabling the sub-structure to be built as on dry land. For greater depths, or for very difficult bottom, access can generally be had only with very expensive pneumatic caissons.

If the bottom is strewn with boulders it is likely to be hard and strong enough for short-span piers, and may generally be cleared by dragging, scraping or by divers, sufficiently to permit the construction of a cofferdam there; or if the depth and velocity of water is too great, a log crib filled with stones may be sunk and concreted for the foundation of the upper part of the pier.

FOUNDATIONS

Soft bottom can often be excavated by dredging, and piles be driven and cut off by a submerged circular saw and thus made ready to receive pier footings built in cofferdams that are not pumped out until after a few feet of concrete has been deposited on the pile tops to seal the bottoms of the cofferdams.

In other cases, the lower parts of the piers can be built in floating caissons or cofferdams with detachable bottoms that are towed to position, sunk to rest on the pile tops, and the piers completed, after which the sides of the cofferdams are removed, leaving the piers supported on the bottoms of the caissons interposed between them and the pile tops. In such cases the caissons can be made with either wooden or concrete bottoms, the latter thus being made integral with the pier shaft if necessary. Sometimes clusters of wooden piles are driven in thin steel cylinders that have been sunk a short distance below the river bed and are subsequently filled with concrete. Groups of concrete piles with their tops extending above water level are sometimes used for the foundations of piers or for light work; these piles are sometimes continued up to form the pier as well, and constitute the sole support of short spans.

(To Be Continued)

Winter Work for the Street Force

The Street Division of Waltham, Mass., last winter managed to find a number of jobs to do that were worth while. A street that had been graded to sub-grade was covered with gravel, to be compacted by traffic and leveled off and surfaced in the spring. Sand to be used in connection with oiling roads was dumped in piles along the roads where it would be needed. Grading and widening two or three roads was carried on. At

the city quarry rock was got out ready for crushing, about 200 tons during February alone, and the crushing machinery was put in order. The steam road rollers were thoroughly overhauled and extensive repairs made. Paper on the refuse dumps was baled and stored at the city stables until better prices were obtainable, twenty or more tons being baled.

Complete Road Plant in Iowa

Camp and central mixing plant midway of a five-mile contract. Unusually complete plant. Long haul of concrete not objectionable.

A description of an unusually complete contractor's plant for road construction is given by the Service Bulletin of the Iowa State Highway Commission. This is the plant of the Horst Construction Co., built in connection with the construction of a 5.14 mile concrete road in Cerro Gordo County.

J. W. Horst, of that company, located a construction camp about midway of the contract, carefully designing and staking out a camp site including a mixer and material bins, stiff-leg derrick, cement sheds, garage and office. A standard railway track was laid from a near-by railroad to the plant and an industrial railway track for hauling cement from the sheds to the mixer. The contract was awarded on March 17, 1920, and a camp was under way before the frost was out of the ground.

At this camp was located a central mixing plant, this being the first road construction from a central plant tried out in Iowa. The mixer was placed on concrete foundations, and a concrete pavement was laid where the trucks were to stand for receiving the concrete from the mixer and the space around it was carefully drained and graveled. A good roadway was built leading from the mixer to the highway and in addition the public highway was graveled for the stretch to be used by the contractor's truck. The mixer structure was so arranged that canvas could be spread to protect the men and machinery from sun and rain.

The outfit for this job included 15 one-ton Ford trucks with dump bodies and 2 with general service bodies, a Lakewood finishing machine, a Koehring concrete mixer, a Buffalo stiff-leg derrick with one-cubic-yard clam-sheel bucket, 18 ten-foot sections of Blaw-Knox road forms with pins and wedges, 3 Domestic force pumps, 11,940 feet of two-inch black-iron pipe with expansion joints for every 1,500 feet and unions for every 800 feet and T's for every 150 feet, an auto truck turntable, a 1,000-foot railroad siding and an elevated industrial railway track from cement shed to mixer.

Thirty men were employed at the plant, 3 working between the railroad cars and the cement shed and the industrial cars to the mixer station, 2 handling cement from the industrial cars to the mixer platform, 2 charging the mixer, 1 mixer operator, 1 derrick operator and a helper, a chief mechanic in garage and 2 helpers, 2 turn-table men, 3 concrete spreaders, 2 men on finishing, 2 form setters, 4 subgraders with a team, 1 horse for hauling cement, and 3 men covering and wetting concrete.

From the start the work was organized and run on a regular schedule, trucks arriving at the plant and departing on the minute. Every truck in going to the mixer passed the garage where the master mechanic immediately took out of service any which was crippled or needed attention of any kind and a reserve truck was substituted in its place. At night all 15 trucks were lined up in front of the garage and given an inspection and prepared for service the following morning.

At the road where the concrete was to be deposited was a portable turntable which was dragged ahead from time to time so as to be kept a short distance ahead of the construction. The loaded truck ran up on the turntable, was turned in a few seconds by two boys, backed the few feet required and dumped its load and returned; all this without the delay and cutting up of the subgrade which absence of the turntable would have made necessary.

The longest haul was about three miles. It was found that by carefully noting the length of haul and the moisture condition of the sand and gravel and varying the amount of mixing water to suit both conditions as well as the atmospheric condition, the wet concrete mix could be delivered on the subgrade at the laying point in even and uniform condition, capable of passing every test and meeting all requirements. There was little or no trouble on even the longest hauls with a separating of the materials, nor in initial setting of the mixed material before it was placed. The average length of time a load of mix was on the road on the longest haul was approximately 15 minutes. Probably not more than half a dozen loads of mix were lost on the entire work because of delay in delivery occasioned by accident to the truck or otherwise.

During the few minutes of transportation the mixed concrete absorbed the water more thoroughly and appeared somewhat stiffer when spread than does that from a mixer on the spot, but there was no special difficulty in working and shaping it with template or tamping devices or finishing machine. Belting was a little more difficult because less water came to the surface and the surface material was more sticky and the belt had a tendency to drag small stone to the surface. Such stones were picked out and additional belting restored the workability of the surface and removed all traces of holes. Some engineers who inspected the work thought the central mixed concrete worked up better in the end than the locally mixed type, some thought the reverse and most engineers could see no difference.

The central mixing plant was especially well adapted to this particular job as there were numerous curves and narrow places in the right-of-way and cuts which would have interfered seriously with the use of an industrial railway had this been used for bringing the aggregate materials or hauling the dry mix.

This contract comprised 21,060 cubic yards of excavation at $1.31 and 54,435 square yards of concrete surface at $3.74, a total of about $231,000. The concrete was 8 inches thick at the center and

7 inches at the edges and the roadway was 18 feet wide.

The average daily run (10½ hours work), in spite of almost daily shortage of materials, was 365 lineal feet or 730 square yards. The maximum daily run was 600 lineal feet earning for the contractor $4,488. The day's work was ten and one-half hours.

Making Narrow Roads Wider

By John Stanley Crandell*

Adding a shoulder of bituminous macadam on each side of a narrow concrete road. Details of construction method.

There is a very large mileage of narrow hard-surface highways that have become inadequate through changing traffic conditions. Many of these roads are requiring excessive maintenance. Others have not yet shown the effects of the increasing traffic.

Various schemes have been tried to widen these roads without undue expense. Of them all, the plan to extend the width by building bituminous macadam shoulders has been the most widely used, and gives the most promise. In addition to the large mileage already built, many roads have been planned, or are under construction, that will eventually have to be widened. Provision should be made in the design of all new roads to take care of constantly increasing traffic of the future, and to that end, shoulders should be built at the time of construction.

Much progress has been made in highway design, construction and drainage, but the question of shoulders has been overlooked. Many costly highways still are constructed with earth, gravel or water-bound macadam shoulders, which are inadequate for present-day motor truck traffic. Shoulders of these types are rapidly worn out or destroyed, and thus become sources of danger, imperiling the life of the motorist who turns out to let another vehicle pass.

Nine-foot roads can be widened to any desired measurement by building shoulders on each side. The 9-foot road then, being in the center, takes most of the traffic; whereas, if another 9-foot strip be built alongside the original construction, traffic will straddle the old and the new with consequent unpleasant riding. In many localities the existing 18-foot roads are being found inadequate, and they are being widened to 24 feet by building 3-foot shoulders on each side. Six-foot shoulders also have been tried with success; in fact, a 6-foot shoulder is easier to build than one of lesser width.

There are certain practical factors that must be taken into account when this work is attempted. In the first place, the depth of the new shoulder must not be slighted. Eight inches is the minimum that should be allowed, for it must be remembered that these shoulders will have to take heavy loads, and that they will not be an integral part of the original road and thus will receive no support from it.

Gravel or water-bound macadam shoulders may be turned to good account by using them as foundations on which to place a bituminous macadam wearing course. It is good practice to build water-bound macadam shoulders when the highway is being constructed, with the idea in mind that at the end of the first year the shoulders will be topped with bituminous macadam.

The following paragraphs describe the best standard practice of laying tar macadam shoulders in widening old roads:

A trench for the new shoulder must be dug alongside the pavement, and no more earth should be taken out than may be necessary. It is sometimes difficult to roll the bottom of the trench uniformly, and therefore it is important not to disturb the sub-base. Any soft spots must be replaced with new earth, after making sure that these places, and any others that need it, have been properly drained. The berm adjacent to the shoulder should be leveled off so as to insure all surface water finding its way into the side ditches.

If possible the earth base should be rolled, and for this purpose a light tandem roller is best. If a 3-wheel roller is the only one available, then the rolling must be done with one rear wheel, unless a very wide shoulder is being built. Care must be taken during this rolling to see that the edge of the pavement is not chipped or broken.

Six inches of stone (stone that will pass a 3½-inch ring and be retained on a 2½-inch ring) is then deposited on the earth base and rolled to 5½ inches in depth. This forms the foundation for the shoulder. The voids are filled with sand or screenings, and the foundation is rolled until it resembles a water-bound macadam, additional filler being added from time to time, if required.

A tar-macadam wearing course is then constructed by placing a 3-inch layer of tough, hard 2-inch stone on the foundation. This is rolled to 2½ inches in depth, and then hot Tarvia-X is applied at the rate of 1.7 gallons per square yard. Where the job is not of great extent, hand pouring pots may be used, and the Tarvia may be heated in kettles on the job. But if there is considerable yardage it will be found more economical to apply the binder from tank wagons or from motor truck distributors. The wearing course should be prepared a long distance ahead, since the spraying of Tarvia, either from tank wagon or distributor, is done rapidly and this part of the work should not be delayed.

The first coat of Tarvia-X is covered with ¾-inch stone chips, which are rolled into the voids of the wearing course. Those chips not held by the binder are swept off, and a second, or seal coat of Tarvia-X is applied at the rate of ¼ gallon per square yard. This is covered with pea-gravel, or stone chips, and the shoulder is

*Consulting Engineer, General Tarvia Dept., The Barrett Company.

well rolled. When the seal coat is being applied, see to it that an extra quantity of Tarvia is introduced along the joint to insure its being absolutely waterproof. If water finds its way in here the sub-grade will be softened and the shoulder may be depressed at that place.

Maintenance of all shoulder work is absolutely essential if good results are expected. Shoulders are subjected to exceptionally heavy thrusts from laden motor trucks running at high speed, and they must be kept in first-class condition throughout the year if they are to give the service desired. Holes that may form should be patched as soon as they appear, and the entire shoulder should be given an occasional treatment with Tarvia-B.

In the case of new roads, the work of constructing shoulders is simplified, since the sub-grade for the shoulders can be graded and rolled at the time this work is being done for the pavement itself.

Pre-Cast Concrete Slab Pavement

About half a mile of a new type of concrete highway pavement was built last winter by the Wyoming State Highway Department to carry very heavy oil-field traffic over the gumbo flats and sandy stretches between Casper and Salt Creek.

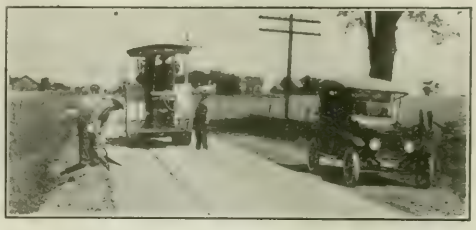
In 1917 the State Highway Department and the Mid-West Oil Company united in grading and draining a 39-mile section of the road and during 1919 paved 5 miles with concrete 16 feet wide. This road has been subjected to a heavy traffic estimated at 10,000,000 pounds per month besides a hundred additional motor vehicles daily that require a high-class hard-surface roadway.

To concrete the road in situ in the usual manner with a traveling concrete mixer would have involved great expense and difficulty in the delivery of materials because there was no supply of aggregate except at one point and it would have been necessary to install an expensive water supply plant. It was therefore determined to built an experimental length of 24,000 feet of the roadway with pre-cast slabs manufactured in a yard at Casper, at one end of the road adjacent to the supply of aggregate and water.

The State Highway Department designed 8 x 9-foot slabs 6 inches thick reinforced with wire mesh and ½-inch bars, which were made and laid by the Levy Construction Company, Denver. The slabs were made in six equal lots, each of them having a different type of joint, some of which were straight, some beveled, some curved and some interlocked and bolted together. The work was not commenced until late in the season, and was continued into very cold weather when the mercury went far below freezing, much increasing the cost of preparing the sub-grade and making it necessary to heat the aggregate and mixing water.

The slabs were delivered from the yard to the site by State Highway trucks at a cost of 39 cents per ton-mile. They were loaded and unloaded by 3-ton triplex chain hoists suspended from trolleys on traveling gantries that spanned

TRENCH AND BASE STONE FOR SHOULDERS



FILLING AND ROLLING BASE COURSE

POURING PENETRATION COURSE AND APPLYING KEY STONE

ROAD WITH SHOULDERS COMPLETED

Trench excavated 7½ in. deep and 4 ft. wide. Base stone placed 5 in. thick and 4 ft. wide. Wearing course 2½ in. thick and 3.5 ft. wide. Finished surface 16 ft. wide.

SHOULDER 3.5 FEET WIDE ON EACH SIDE OF A 9-FOOT CONCRETE ROAD; FOUR MILES NORTH OF KAUKAUNA, WISCONSIN.

the road. They were laid with one 8-foot side coincident with the center line of the roadway, thus forming a continuous strip of pavement 9 feet wide that could be duplicated by slabs on the other side center line, making up the full width of 18 feet. Up to the present time the pavement shows no deterioration under heavy traffic and the best type of joint has not been determined, although the interlocked type is considered least desirable.

Engineering Costs on Montana Roads

The second biennial report of the Montana State Highway Commission gives among many other interesting data, the cost of pre-construction engineering and of construction engineering, both total and as percentages of the construction cost. Pre-construction costs include reconnaissance or investigation, preliminary and location survey, plans and specifications, advertising for bids, contract letting, and miscellaneous.

For all contracts let to date, totaling 661.44 miles and $6,222,689, the pre-construction charges average 1.84 per cent of the contract price. Surveys are made for some projects that are never carried out, but the cost of these to date has been less than 0.3 per cent of the total construction costs to date.

Construction engineering charges to date have averaged 6.46 per cent on grading and gravel roads, 3.53 per cent on paved roads, 4.61 per cent on bridges; or 5.58 per cent average of all road and bridge projects.

Federal Aid Road Work

By Thos. H. MacDonald*

Federal aid to the extent of $216,000,000 paid or obligated, leaving only $50,750,000 unobligated. Road construction has not kept pace with traffic increase. Heavy construction this year will be followed by a decided reaction next unless Congress makes another appropriation for Federal aid.

Except in a few states, Federal aid funds for road building will be practically exhausted at the end of the present calendar year. On the first of January, 1921, of the $266,750,000 of Federal funds allotted to states, there was either paid on completed work or obligated by approved projects approximately $216,000,000, leaving approximately $50,750,000 unobligated. On that date $149,683,107 of Federal aid was either actually under construction or completed, leaving $117,066,893 available for new contracts. This last amount has since been reduced so that at present but little more than $100,000,000 is available for new contracts and this amount did not become available until last July. Considering that after funds become available some time is needed for making surveys and plans, advertising for construction and letting contracts this record seems very good.

The total amount paid or due states on March 1, 1921, for work actually completed was $89,337,889. On that date there had actually been paid out of the United States treasury $62,867,284, so there was then due the states $26,470,605. There is a lag between the completion of construction work and the actual disbursements from the treasury due to the fact that many of the state have been carrying the cost of the projects which are under way until they are nearly or entirely completed.

The total mileage under construction and completed in the United States on March 1, 1921, was 22,032 and the total estimated cost for this mileage is $361,946,868. Based on the total estimated cost of approved plans the percentage of types was approximately as follows:

Type	*Per Cent*
Earth	8.685
Sand clay	3.713
Gravel, plain and surface treated	19.823
Macadam, waterbound and surface treated	2.564
Bituminous macadam	6.346
Bituminous concrete	5.548
Portland cement concrete, plain and reinforced	38.464
Brick	4.799
Miscellaneous	4.040
Bridges	6.018
Total	100.000

During the war period road construction gave way to war activities. During 1919 and the early part of 1920 the rising costs of labor and materials indicated the desirability of a moderate program of construction to avoid undue absorption of labor and material supplies to the detriment of production in other lines of activity. Many of the states purposely delayed their road construction programs in the hope that prices would fall. This action affected all road construction, whether Federal Aid, projects paid for entirely by the state or by counties, towns and cities. During 1920 the added influence of extremely unfavorable railroad transportation conditions brought road construction nearly to a standstill.

During the latter part of 1920 many of the states apparently became alarmed because of the adverse railroad transportation conditions and to assist in bringing relief through truck transportation, resumed road construction. During the winter following the repressive influences appeared to be less in evidence. Now in the spring of 1921 with falling prices, an apparent over-abundance of labor and more favorable railroad transportation it is expected that the mileage of roads constructed during 1921 will be unprecedented in

*Chief, of Bureau of Public Roads, United States Department of Agriculture.

the states having ample funds available. During 1920 a little over $91,000,000 of Federal aid road funds were put under contract and it is estimated that were it available between $125,000,000 and $150,000,000 would be put under contract during 1921.

Some of the states have already practically absorbed their total apportionment of Federal aid. Of these there are the twelve states of Delaware, Florida, Georgia, Idaho, Illinois, Louisiana, Maryland, New Hampshire, Oregon, Rhode Island, Washington and West Virginia. States still having a considerable balance of their apportionment available for new contracts are the nine states of Alabama, California, Indiana, Michigan, Missouri, New York, Texas and Wisconsin. In all of these last named states, however, it is expected that a large mileage will be put under construction during 1921.

As indicating in general the attitude that state highway departments are now assuming the following quotation is made from a statement by the Illinois State Highway Department:

"The indications now are that building conditions are gradually improving. We can safely look for cheaper materials and a larger supply of labor at less cost, as well as an improved transportation situation. It is possible that during the coming year (1921) we may see the cost of road building decreased to the prices prevailing in the spring of 1919 with a possibility of even a greater reduction in the following year. It is also the opinion of the majority of the prominent financiers of the country that within the next few months the forces now working towards a readjustment in all lines will bring about a corresponding readjustment of interest rates, which would mean the ability of the state to market its road bonds on a more satisfactory basis than at present."

It may be seen, therefore, that while during the war and later during 1919 and 1920 road construction where possible to carry it on at all was carried on under very adverse conditions, the prospects for 1921 seem excellent and just now I see no cause for worry about the progress of Federal aid road construction. Indications point to the construction of a very lengthy mileage. It is very fortunate that this is so because a large expenditure for road construction aside from the very considerable normal benefit which it will confer will very measurably diminish the force of the rising tide of unemployment. During 1922, unless additional Federal aid is granted there will be a very decided reaction in road building throughout the whole nation. It will be felt somewhat during the latter part of 1921 and the early part of 1922 in any event as the states in many, if not most cases, must legislate to meet any new Federal appropriation and the legislatures in quite a large number of states must be called in extra session as they have now adjourned for this year and do not meet again regularly for two years.

The consensus of opinion is that the expenditure of Federal funds for road construction has not only been a very profitable investment due to the great increase of property values, and the extension of transportation to the benefit of commerce and industry, but it has had a large educational effect, has encouraged and stimulated state and county road construction, has promoted coordination of road programs in different localities and measurably forwarded the adoption of better standards and better construction. As above stated, projects already under way will, within a short time, exhaust the balance of the Federal funds now available, and on account of the tremendous value and importance of abundant good highways for agricultural, industrial and commercial interests, for their military importance and great value in supplementing overburdened railroad service, it seems vital that the work should be extended and provision made for it by the assurance of continued Federal appropriations of a substantial amount each year for a period of years.

Highway transportation is still far from a well-advanced stage of development, although great forward strides have been made in it. Highway production has always lagged behind the activities depending upon it. To-day on the eve of still greater activity the pressure of industry is such as to threaten the collapse of our main transportation system. The wealth of the nation has been increasing at the rate of approximately 10 per cent a year; the basic annual production of the country has been increasing at a rate in excess of 15 per cent a year; motor vehicle registration has been increasing at the rate of approximately 23 per cent a year; whereas the production of important highways has been increasing at the rate of about 6 per cent a year. It is very evident, therefore, that the production of surface roads is not keeping pace with the increase in wealth of the traffic of the country.

Federal aid has been a very great stimulus to highway production throughout the country. It has resulted in the establishment of state highway departments in every state. Through it has come about the training of a body of engineers capable of intelligently designing and supervising road work, the co-ordination of state highway departments to direct it, the development of important and abundant road building machinery, the provision of a large amount of construction plants and equipment by the states, as well as the building up of a corps of general contractors who have undertaken to do highway work. Through its influence more than forty states have already established the system of main roads that aggregate approximately 8 per cent of the mileage of rural roads in the United States. It has brought about a better understanding of the nation's needs for roads and a better understanding of the adjustment of road types to road traffic.

A large mileage of road must be improved, and while the most costly and most durable types are being adopted for the business centers it is also necessary to build a very large mileage of lower cost roads selected with proper consideration for local conditions and requirements.

It is believed there is no work more necessary, more pressing or more vital to our prosperity than a large highway construction program, and financial support by the Federal government seems advisable.

Lighting Highways

A new type of reflector developed especially for lighting country highways.

One of the features proposed for the "ideal section" of the Lincoln highway, concerning which much has been said recently (see PUBLIC WORKS for Feb. 19), is the lighting of the highway at night. An important advantage of this is the great reduction in accidents which would undoubtedly be effected. Partly because of this, it would also tend to increase night traffic and thus relieve day congestion and also increase the amount of service obtained from the road and increase the returns to the community from their expenditure on its construction.

A large percentage of automobile accidents occur at night and a considerable portion of these are due to headlight glare. Many types of reflectors and lenses for headlights have been devised to reduce the danger from this cause, but with far from satisfactory success. Undoubtedly it would be much more desirable to have the highways as well as the city streets so lighted that the use of glaring headlights would be unnecessary. The chief reason for not adopting this remedy is, of course, the cost involved.

The General Electric Company is offering a new type of incandescent lamp reflector which it claims will permit the economical lighting of highways, a test installation having been placed at Swampscott, Mass., after months of study and experimenting by the company's illuminating engineers, which installation is shown in the accompanying illustration. Incandescent lamps of 250 candle-power are used, placed at a height of 30 feet at intervals of 400 to 600 feet and set to so illuminate the roadway that there is no need for glaring headlights. The essential feature of this lamp is a new type of reflector known as the parabolic nest highway lighting unit. There are three reflectors, one within the other and by means of these the greater part of the light that would with ordinary reflectors be reflected upward or on to the adjoining fields is concentrated upon the road surface, the rays making an angle of 10 degrees below the horizontal and giving the same effect as an overhead reflector 15 feet in diameter. White reflecting surfaces reduce the glare from the lamp without the aid of diffusing globes.

The bracket holding the reflectors is adjustable in both vertical and horizontal direction so the fixture can be mounted on a pole close to the edge of the highway or several feet back from it, and can, if desired, be turned so as to illuminate curves or hillsides.

PARABOLIC NEST HIGHWAY LIGHTING UNIT

The cost of this lighting is not stated. It would seem that it should logically be paid from the same fund from which the highway itself is constructed and not be assessed upon the abutting property, since it is a benefit not to the farmer along the road, but to the users of the road. It would not involve any additional cost for poles where there are already telegraph or telephone poles along the road at intervals of not more than 600 feet, but would require not only the placing of lamps but the running of wires for supplying them with current except in cases where such wiring already exists. Wires run for this purpose, however, can and probably would be used by farmers along the highway for lighting their houses or supplying current for farm and household electrical conveniences.

DAY VIEW OF PARADISE ROAD, SWAMPSCOTT

NIGHT VIEW OF PARADISE ROAD, SWAMPSCOTT

PUBLIC WORKS

Published Weekly
by
Municipal Journal and Engineer, Inc
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.

Subscription Rates

United States and Possessions, Mexico and Cuba....$3.00 per year
All other countries .....$4.00 per year

Change of Address

Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

CONTENTS

SHORT-SPAN HIGHWAY BRIDGES—Illustrated 313
Winter Work for the Street Force 316
COMPLETE ROAD PLANT IN IOWA 317
MAKING NARROW ROADS WIDER—Illustrated —By John S. Crandell 318
Pre-cast Concrete Slab Pavement 319
Engineering Costs on Montana Roads 320
FEDERAL AID ROAD WORK—By Thos. H. MacDonald 320
LIGHTING HIGHWAYS—Illustrated 322
EDITORIAL NOTES 323
No End to Road Work in View—Everlasting Roads—Automobile Fees—Distributing Road Construction Costs—Practical Solution of a Highway Problem
Pavement Bids in Gary 324
FEDERAL REPORT ON CALIFORNIA ROADS.. 324
Location, Grading and Drainage of Highways..... 325
PREVENTING CRACKS IN CONCRETE PAVEMENTS NEAR CULVERTS—Illustrated 326
Increased Highway Costs in Oregon 327
ROAD IMPROVEMENT AND DRAINAGE—Tables 327
SOUTH CAROLINA HIGHWAY DEPARTMENT 335
STATE ROAD WORK IN 1920 AND 1921—Table.. 336

No End to Road Work in View

More than three hundred thousand miles of rural public roads in the United States have been surfaced with more or less permanent construction at a cost of more than two billion dollars. This length would give one hundred transcontinental routes if concentrated in continuous east and west lines, or one for about every ten miles of latitude.

But large as is the amount of surfacing completed, there remains more than seven times this mileage that has not yet been surfaced. And as the country develops this mileage will be added to. There is therefore no immediate prospect of road construction work giving out.

But in addition to this, there is an enormous amount of maintenance and reconstruction work to be done. Last year about fifty million dollars was spent on maintenance alone, and it is realized that even more should be spent, and in the future must be spent, on this class of work if the roads are to be preserved from rapid and complete destruction.

Everlasting Roads

A Chattanooga paper, in commending the construction of a concrete highway in Hamilton county, Tennessee, on the pay-as-you-go principle, says: "The people of Hamilton county will have secured a permanent highway—a road that will last forever—twenty miles in length within the period of three years, and there will not be a bond outstanding to be taken up later because of it."

Any good roads advocate who tells the taxpayer that a concrete or any other road will "last forever" is laying up trouble for himself and a set-back for the good roads movement when, in two to five years, the taxpayers are disillusioned as to the everlastingness of the pavements. It does not pay in the long run to attempt to deceive them, and many are becoming wise to the untruth of such claims.

Automobile Fees

Most of the states are applying a part or all of the fees received from the registration of automobiles and licensing of chauffeurs, operators and dealers, to the maintenance or construction of roads. In 1920 $97,997,160 was so used, which was 96 per cent of the total amount of such fees collected by all the states. Even so, however, such fees provided less than a fourth of the total road expenditures. Were the fees doubled and all applied to road construction, they still would not pay as large a proportion of the cost as the deterioration due to automobiles is of the total wear of the roadways.

In fact, in most states practically the only wear is that caused by automobiles and this is being recognized. Illinois, Maine, Minnesota, Missouri, Nevada, Utah and Wyoming have adopted the plan of capitalizing the motor vehicle revenues for road construction, by issuing bonds and paying interest or principle or both from the motor vehicle revenue.

Distributing Road Construction Costs

The general idea at the basis of both federal aid and state aid in road construction is that the wealthier sections should aid the poorer ones in paying for roads through their territories, partly because these roads are used as through routes by inhabitants of the richer and more populous districts, and partly because the prosperity or poverty of any district reacts upon the entire state and country.

Some states, however, have not embodied this principle in their highway laws. In Kansas, for instance, "state aid" consists of collecting motor vehicle fees and handing over to each county 50 per cent of the fees collected in that county, which can be used for paying one-fourth of the cost of hard-surface roads built by the county. In Arkansas some of the poorer counties receive so little aid that they are using shot guns to prevent road construction by levying of taxes equal to a very large percentage of the entire value of their farms.

State compulsion rather than state aid will quickly rouse antagonism to good roads in place of the now almost universal approval of them, and cause a serious set-back to the movement.

Practical Solution of a Highway Problem

Construction problems, like any others, must be understood before they are solved, and after the cause of the difficulty and the desired remedy are determined, the simplest and most efficient economical practical remedies should be devised and applied. This is well illustrated by the description on page 326 of the successful methods for preventing injury by frost to concrete pavements adjacent to culverts. The engineer and contractor, who is an experienced road builder, lost no time in attempting to prevent the natural action of the frost but merely tried to remove the conditions that caused this action to be injurious to his structure. He noted that a certain part of the structure was necessarily exposed to the full effect of the frost and another part was exposed to no effect. And he therefore by a very simple and direct method provided for the actions between the two points so that they should be regular and under control and would operate in a way that the structure was designed to receive without injury. The results were all that he desired and he has established a construction detail that may be advantageously adapted for concrete pavement in cold climate and will save a large amount of injury to pavements and traffic and costly repairs and maintenance at a moderate initial construction cost. Engineers and contractors should emulate this direct method of investigation, analysis, and design, and whenever the work appears to be unsatisfactory or the behavior of a finished structure is not what is desired, the reason should be searched for and when found measures taken to eliminate it or, as in this case, to control it within practical limits, and design the structure to correspond with the definite requirements. Usually natural forces and operations can be directed rather than controlled or eliminated and the work should be designed and constructed so as not to require unnecessary resistance to them.

Pavement Bids in Gary

Bids on paving work were received on March 21 by W. P. Cottingham, city engineer of Gary, Ind. Sheet asphalt, asphaltic concrete, asphalt macadam, reinforced concrete, and sidewalk, curb and gutter were bid on. The sheet asphalt pavement consisted of 1-inch binder and 1½-inch wearing surface; the asphalt concrete of a 2-inch course with no binder course. Each of these are to be laid on the present pavement regraded. Bids were asked on use of Trinidad, Mexican and Texaco asphalts, and Trinidad and Mexican asphalts combined. The reinforced concrete pavement is one-course, 7 inches thick. The total of the low bids on the seven contracts was about $150,000.

All the work is to be paid for with bonds issued upon completion of the work against the property benefited. Bonds for work on Delaware, Pennsylvania and Madison streets and 19th avenue, in the center of the city, can be discounted by the contractors at about 5 per cent, says Mr. Cottingham, but those on the outlying streets carry a much greater discount and are not attractive.

Mr. Cottingham explains that "The low bidder on the sheet asphalt pavement resurfacing work —Municipal Construction Company—has a plant in town, left from last season's work here, and was very anxious to secure the work in the first letting and consequently cut its bid to make sure of it when it was seen that there would be some outside bidders."

This company bid $1.67 on Trinidad and $1.57 on Texaco and Mexican sheet asphalt on three streets and 10 cents more per square yard for each on the fouth; while one of the other bid $1.85 on Trinidad and Mexican combined and the other bid $3 on Mexican, in each street. These prices do not include regrading the present pavement or any work other than the paving proper.

For asphalt concrete the Municipal Construction Company bid 10 cents per square yard less than for sheet asphalt in each street, the second bidder 25 cents less, and the third did not bid at all. None of these three bid on work on the outlying streets, where the only bid was $2.75 for Trinidad and $2.60 for either Mexican or Stanolind.

For reinforced concrete a bid of $4.51 was made on 19th avenue and $3.77 and $4 on two outlying streets.

Asphalt macadam bids ranged from $3.50 on one street where there was only one bidder, to $2.25 on another street with two bidders.

Federal Report on California Roads

For several months past there has been severe criticism in many quarters of the work done by the California state highway department, the special criticism being that the millions spent by the state on roads have been practically thrown away, since the roads are too narrow for the volume of traffic using them and too thin for present-day truck traffic.

Those defending the work of the commission maintain that the insufficiency of the roads is not nearly as great as claimed by their critics and that even if it were, the commission was justified in adopting this type of construction by its ability thus to extend the road system into all sections of the state, which would have been far from possible had a wider and thicker road been built.

The subject is discussed at length in a report of the Bureau of Public Roads, which has recently been made public. This report says: "That the thin, narrow pavement and close grading en-

abled the rapid extension of very serviceable miles of roads is without question, and that the implied order in the Legislative Act of 1909 demanded extension, is equally evident. Because the second bond issue was voted in 1915, and the third in 1919 may, in a sense, indicate such a capacity for road financing by the state as to deny the assumption that the state of California, at any time, was obliged to take chances with thin pavement in order to produce mileage, but it is undeniable that the very extension of the pavement developed sufficient sentiment to provide additional money in 1915, and again in 1919.

"So it cannot be said in 1920, in the light of the fact that the great usefulness of the highway system is now proven, that the state would have realized its usefulness and provided in equal volume had not the system been extended as rapidly as it was, and at some sacrifice of either temporary or ultimate durability to increased mileage.

"Although for the most part the service rendered by the roads built is still uniformly good, it is very evident that the state can now well afford to raise the standard of construction. This standard must satisfy all motor vehicle operators. The increase in the use of the trucks will doubtless for a time be increasingly rapid. It has been over 500 per cent during the past three years, and will demand a greatly increased factor of safety in the pavement."

The cost of the roads to California is declared to be low. Prior to 1917 the average price of concrete roads, including grading and structures, is given as $1.14 per square yard, which is declared as "remarkably low." The price since 1917 has been $1.84, which the report says is also low.

The cost of the thin asphalt surface is given as between 8 cents and 9 cents per square yard. In the opinion of the Bureau of Public Roads this thin asphalt does not "serve a purpose commensurate with its cost."

Criticism of the specifications of the Highway Commission is voiced in the statement: "The original lean concrete mix of 1:2½:5 for a pavement should have been abandoned sooner," and that the requirements "for coarse aggregate with respect to size, grading, quality and cleanliness are, in the light of recent development, somewhat inadequate." It is declared that the present finishing can be improved. "The omission of transverse joints," the report says, "appears to have been a justifiable innovation particularly in a frostless country, but it is believed that there should be exceptions to this practice."

"The present requirements for a 1:2:4 concrete mixture," the report says, "if laid dry should produce a good pavement for traffic preponderantly rubber-tired, but it is noted that several states use a richer mix." The present specifications for reinforcement are declared excellent.

On the thinness of the concrete slab the report comments as follows: "This concrete pavement is the thinnest that has been extensively laid in any state, and would have been rejected as too thin in any state subject to winter frosts. It is one foot narrower than the minimum width of concrete roads built in most other states, and it is believed that under present general conditions it is at least 3 feet too narrow."

Heavier designed roads for sections where the sub-grade is adobe, clay or adverse soils is also advocated with a further recommendation for experimental construction.

The investigating engineers examined practically all the pavements in the state, 1,365 miles, and classified them as A, B, C, D, E and F; A being a pavement in practically perfect condition; D a pavement so cracked transversely and longitudinally that numerous small slabs are formed that, however, do not average less than 50 square feet area; E a pavement in which such slabs have an area less than 50 square feet but in which there is no general disintegration; and F, pavements badly broken and with disintegrated portions. They found only 12.5 per cent of the pavements to be in the last three classes.

Six hundred and thirty-eight cores were drilled in the pavement, these having 4½ inches diameter, the object being to determine the depth of concrete, the strength, analysis of constituents, etc. "Measurements showed a surprisingly close average of 50 per cent coarse aggregate in both the 1:2:4 and 1:2½:5 concrete." The depth varied considerably, but in general ran greater than the specified four inches. The average compression test, corrected for cylinders 9 inches high by 4½ inches diameter, averaged well above 3,000 pounds; but there appeared to be a slight decrease in compressive strength with the age of the concrete.

It appeared that there was little if any decisive evidence that reinforcement in 4-inch or 5-inch concrete has proved effective on the adobe and other adverse soils.

The engineers believe that special treatment will be necessary for adobe and clay soils in addition to increasing the thickness to 5 inches. This may consist of increasing the thickness to 6 inches and possibly some corrective treatment of the sub-grade such as mulching the shoulders to prevent evaporation and giving the sub-grade less crown. It is proposed that short sections of tentative design should be built as frank experimental construction to determine the workability and economical design for roads on such soils.

The report states that the financial administration has been "scrupulously honest," that the system was well planned, and that most of the reasons for criticism were brought about by an effort to produce the largest possible mileage with limited funds.

Location, Grading and Drainage of Highways

A book with the above title has just appeared written by Wilson G. Harger, engineer in the New York Department of Highways and one of the authors of Harger & Bonney's "Highway Engineers' Hand-book." This is stated by Mr. Harger to be the first of a series of four volumes, the other three of which are in preparation, which are to cover the entire road problem from the standpoint of the constructing engineer. This volume discusses general principles governing the

policy of highway programs, while the future books will be devoted to selection of pavement type, methods of construction, maintenance and reconstruction, detail methods of field and office work, and construction engineering and inspection.

The six chapters in this volume are entitled: "General Principles of Economical Highway Design," "Proportion and Economy in Design," "Classification, Route and General Engineering Location," "Grades and Alignment," "Cross Sections of Rural Roads, Widths of Pavement, Right of Way Clearing," "Drainage." These subjects are discussed quite fully in 278 pages of text, well illustrated by diagrams and appropriate photographs, maps and detail sheets, and contain a considerable amount of tabulated data of various kinds. Throughout there is evidence that the author is familiar from practical experience with the subject of which he writes. It is believed that no student or practicing engineer in highway work can fail to obtain much valuable information from this book.

Preventing Cracks in Concrete Pavements Near Culverts

Well drained stone foundation of graduated depth eliminates injurious frost action by regulating displacements.

Considerable damage is often done to concrete pavements near culverts because of the irregular action of the frost in displacing the culvert and the adjacent pavement. When, as is usual, the foundations of the culvert are carried below frost line and the foundation of the pavement is not carried below frost line, the action of the frost under the pavement results in a heaving motion which raises the pavement while the foundations of the culvert, being below frost level, are not raised. This causes a relative vertical movement between the pavement and the culvert which results in shearing the concrete if no expansion joint is provided along the edges of the culvert.

The top of the culvert remains at the normal elevation while the pavement is raised more or less according to the depth of the frost line, the amount of material frozen above it, and the severity of the frost. When the pavement is laid directly on the earth, or with a considerable volume of porous surplus material beneath it that can be saturated and frozen, the heaving action may raise it from ½ inch to 1½ inches, as was the case at a culvert on route A, section 1, of the New Jersey State Highway, which is illustrated by sketch.

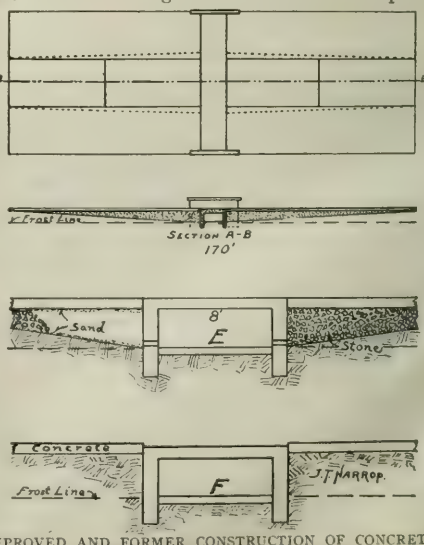
This condition, of course, exposes a sharp transverse edge of concrete to impact and attrition, and causes it to be worn and rounded. When the ground thaws and the pavement settles again in the spring and summer, it in turn exposes a sharp corner of the culvert which is similarly worn and rounded, making a transverse gutter across the full width of the pavement. The pavement does not settle quite to the original position on account of the loose materials filling in under it, and the defect once started grows worse and worse and is a menace to traffic.

PREVENTING THE INJURY

Although it is not practicable to eliminate the action of frost along the entire roadway nor to prevent displacement, both can be done for limited distances and the movements can be so adjusted and regulated as not to injure the pavement. This has been successfully accomplished as shown by detail E, and by the plan and section which illustrate the correction applied by the John B. Harrop Company, engineering contractors, Garfield, N. J., to the New Jersey road that was injured as shown in detail F.

Acting on the principle of the total elimination of the displacement of the pavement adjacent to the culvert and the gradual increase of displacement from the culvert to a remote point on each side of it where it becomes equal to that of the regular road surface without concentrating stresses or rigidly maintaining fixed positions, Mr. Harrop treated the pavement for a distance of 80 feet longitudinally each side of the culvert so as to control the frost action over this space of a total length of 170 feet, reducing the frost action gradually from normal at the extremities to nothing at the center.

This was accomplished by excavating the entire length of the section to form inclined planes starting at sub-grade at the ends and descending to at least 18 inches below sub-grade and below frost line at the culvert. The inclined surfaces were first covered with 2 inches of cinders or coarse sand well tamped and having at the culvert a width 4 feet greater than that of the pave-



IMPROVED AND FORMER CONSTRUCTION OF CONCRETE PAVEMENT ADJACENT TO CULVERT

ment, and, at the ends of the section, a width equal to the regular width of the pavement.

On these inclined surfaces broken stone 1½ or 2½ inches in diameter was filled in up to subgrade level for the whole length of the section. The stone near the culvert was well tamped with hand rammers, and all of it was placed in layers and thoroughly rolled. The rolled surface was covered and sealed with sand or stone screenings, providing a solid surface to support the concrete pavement up to th second expansion joint each side of the culvert.

After the concrete pavement was restored up to the culvert, the drainage under ran freely through the broken stone and escaped through weep holes in the culvert wall, preventing freezing in the stone fill.

As the fill extended below frost line at the culvert, no movement took place here and the surface of the pavement remained always at the same elevation as that of the culvert thus developing no dislocation or strains between the two adjacent structures. As the depth of the stone fill diminished on each side of the culvert the bottom of the stone fill gradually rose above the frost, resting on porous material, greater and greater quantities of which might freeze and heave the concrete pavement more and more as it receded from the culvert until at last the maximum amount of heaving was permitted at the second expansion joints, where divergence between the horizontal and inclined surfaces of adjacent pavement slabs could take place without injuring them. The displacement here, however, was the same as that of the untreated pavement and at the first expansion joint beyond the culvert the displacement of both sides of the joint was also the same so that no injury or relative movement of the surface of the pavement occurred, and no matter what the position or the total amount of upheaval, the two slabs nearest the culvert on both sides always maintained horizontally or inclined positions without injury to themselves or the expansion joints.

The increased width of the bottom of the stone fill at the culvert was provided to prevent earth from being washed in under the edge of the concrete. The work described above has proved very satisfactory and cost (in 1920) about $250.

Increased Highway Costs in Oregon

The rapid increase in wages and prices on highway work in Oregon during the years 1915 to 1920 is very clearly shown in the tabulation which appears below. These prices are all strictly comparative and represent average prices on materials F. O. B. Portland, Ore., and average wages paid on highway work in the immediate vicinity of Portland.

ITEM	Unit	1915	1916	1917	1918	1919	1920	Percentage Increase 1915 to 1920
Labor	Day	2.00	2.50	3.00	3.50	4.50	5.00	150
Man and Team	Day	5.00	5.50	6.00	8.00	9.00	11.00	120
Trucks	Hour	2.50	3.00	3.25	3.50	3.50	3.50	40
Cement	Net Bbl.	1.90	1.95	2.79	2.79	2.79	3.60	90
Asphalt	Net Ton	14.50	14.00	15.55	19.50	23.50	24.00	65
Steel (Reinforcing)	Cwt	3.30	4.50	6.00	4.90	4.40	5.00	50
Lumber	M FBM	32.00	38.00	40.00	50.00	65.00	65.00	100
Powder (40%)	Cwt.	14.00	16.43	21.50	22.25	19.75	21.05	50
Sand	Cu. Yd.	.60	.75	1.00	1.10	1.25	1.50	150
Gravel	Cu. Yd.	.70	.90	1.00	1.10	1.25	1.50	115
Broken Stone	Cu. Yd.	1.15	1.15	1.25	1.45	1.85	2.00	75
Freight (25-mile haul)	Ton	1.20	1.20	1.20	1.50	1.50	1.90	60

Road Improvement and Drainage

Data from more than 500 counties, furnished by county highway officials, giving the total mileage of roads; miles graded, macadamized or graveled, or otherwise improved; the miles drained by deep side ditches, miles drained by underground drains, and some details of drainage.

The data given in the table which occupies the next few pages have been furnished us during the past few weeks by engineers and other officials in charge of county highway work in nearly all of the states. While not all of the counties in the country are represented here by any means, the number is sufficiently great and scattered over the country with sufficient uniformity to give a general idea of conditions throughout the United States.

Following this table is another giving information concerning statewise conditions furnished by state highway officials, and among the data in this latter table will be found the miles of improved roads and miles of unimproved roads in the state. One of the rather remarkable features of these figures is the considerable number of states in which the mileage of improved roads is aproximately 10 per cent of the total mileage of roads in the state; this being the more remarkable when we notice in the county figures the great variations in this respect, some counties having less than one per cent of their mileage improved, while others have nearly 100 per cent improved.

Another interesting feature is the considerable amount of public roads in many of the states which have not even been graded. In general, however, about 30 per cent to 50 per cent of the roads are reported as having been graded.

In spite of the recent development of hard surface highways, it will be noticed that by far the largest part of the surfacing reported from the various states is macadam or gravel, there being almost ten times as much of this as of all other kinds of improved surfaces.

(*Continued on Page* 334)

ROADS UNIMPROVED, IMPROVED, AND DRAINED

Note: Quantities are given in miles unless otherwise stated

County and State	Total miles of public roads	Miles graded	Macadam or gravel	Other kinds of improved surface	—Miles drained by— Deep side ditches	Underground drains	Kind of drainage
Alabama:							
Calhoun	1,100	80	70	.....	one-third	none	.....
Conway	275	157	39	.....	5	.....	.....
Monroe	2,400	205	30	none	205	none	.....
Montgomery	650	500	450	15 sand clay	all	none	.....
Pike	1,200	150	none	150 sand clay	.....	.....	D. S. V. pipe
Arkansas:							
Jackson	250	75	40	none	5	none	shallow side ditches
Lincoln	150	50	15	none	.....	none	.....
Polk	290	160	none	none	100	none	none
Saline	350	116 2-3	35	none	.....	none	.....
Scott	300	200	none	none	100	none	.....
Sevier	220	73 1-3	22	none	.....	none	.....
Van Buren	300	50	none	none	50	none	none
California:							
Fresno	5,000	3,000	25	none	none	none	none
Glenn	600	540	300	34	240	.....	.....
Madera	2,000	1,500	10	26	very little	none	.....
Solano	750	all	5	50 conc. & cem.	all	none	none
Sutter	600	400	200	30	150	none	.....
Ventura	600	400	....	150	.....	.....	.....
Colorado:							
Elbert	200	100	30	none	50	none	Iron culvts. used
Logan	4,200	3,000	200	.....	5-6	none	.....
Ouray	300	100	5	none	none	1	tile
Rio Blanco	450	40	29 shale	none	75	none	.....
Rio Grande	350	all	250	No hard surf. rds.	none	26	Land drainage drains wooden box & vitr. drain tile
Routt	1,800	none	none	none	180	none	none
Wild	7,800	2,500	700	.....	.....	25	vitr. tile
Connecticut:							
Bethlehem	180	3	2½	½	all	none	.....
Greenwich	180	80	20	20	20	.....	.....
Hamden	400	100	50	50	90	10	tile sewer pipe
New Haven	15	5	3 cement 2 mac.	3	all	.....	.....
New London, Windham and Tolland	1,068	30	289	13.5 conc., 35.5 bit. mac.	none	5	rubble drain
Florida:							
Bay	250	160	60 clay gravel	none	4	none	V.C.P. wooden bridges for drainage openings
Bradford	500	300	none	.....	300	none	.....
Duval	200	300	....	10-12 brk.,conc.,asp.	....	none	open ditches
Escambia	1,500	....	10 gravel	3½ conc.	....	none	.....
Flagler	140	110	5 rock	none	20	none	.....
Pinellas	395	395	50	95 vitr. br.	200	none	.....
Idaho:							
Ada	600	200	100	25 pav.	25	none	.....
Bannock	1,000	400	50	4 cind. & grav.	100	none	.....
Boise	500	....	none	none	none	none	.....
Butte	550	25	7 gravel	none	25	none	.....
Caribou	383	122	none	.....	all	none	.....
Custer	526	38	10	none	none	none	.....
Dist. No. 1	324	324	57	none	none	none	side ditches & cu v.
Idaho	500	150	15	none	.....	none	.....
Power	700	350	80 gravel	.....	200	.....	.....
Illinois:							
Adams	1 650	235	100	2 conc.	235	none	.....
Calhoun	350	none	2	none	none	none	none
Carroll	700	100	55	2½	70	1	4 in. & 6 in. farm tile laid 3 ft. to 4 ft. dp. on one side of rd. in side ditches
Christian	1,269	700	none	80 oiled earth	40	20	tile
Clark	1,000	1,000	130	25 pavement	1,000	none	.....
Coles	865	600	175	50 brk. pave.	all graded rds.	25	tile
Crawford	800	nearly all poorly	50	90 gravel, 5 conc.	.....	practically none	.....
De Witt	732	300	none	50	50	.....	.....
Fulton	1,500	1,300	....	30	very few	.....	tile
Henderson	619	400	2	none	400	1	tile
Jackson	1,500	1,000	20	¾ mi. brick	100	2	tile
Jasper	900	700	none	none	10	2	tile
Jersey	634	all	3	¾ conc.	.....	3	tile
Kane	885	300	300	21	.....	.....	.....
Madison	1,175	all	22	89.5	200	none	.....
Marion	1,200	300	1	2 conc.	500	none	.....
Massac	400	all	100	none	numerous	none	none
McDonough	1,095	500	none	none	50	40	tile
McHenry	1,008	1,000	750	3½ conc.	short stretches	3	tile
Monroe	600	150	25	1¾ conc.	300	none	.....
Piatt	600	350	....	7 brick	300	300	tile
Pike	....	2,000	40	1½ conc.	50	only those showing decided seepage	tile
Pulaski & Alexander	965	all	110	none	600	1	tile
Richland	800	600	15	none	500	.....	.....
Saline	600	....	3	17	....	none	.....
Schuyler	800	300	1	5	25	1	tile
Scott	400	....	none	20	.....	.....	mostly open ditches at roadside
Stephenson	1,080	700	100	5	750	2	tile, ½ mi. brick lateral gravel drains
White	1,002	990	75	.....	500	none	.....
Williamson	860	25	5	17	all	.....	.....
Woodford	900	890	15	5	890	100	tile drains

ROADS UNIMPROVED, IMPROVED, AND DRAINED—(Continued)

County and State	Total miles of public roads	Miles graded	Macadam or gravel	Other kinds of improved surface	—Miles drained by— Deep side ditches	Underground drains	Kind of drainage
Indiana:							
Clinton	839.44	all	82.62	756.82	all	none	
Crawford	1,600	150	80	none	200	none	
Decatur	750	750	400	8	all	very few	side ditch & cross drains
Dubois	750	100	100	none	none	none	none
Fulton	2,660	none	200	none	none	none	tile
Howard	760	650	495	10	650	8	red drain tile
Jackson	1,500	1,450	750	50	1,000	1	tile drains, burned clay field tile
Jennings	1,000	nearly all	100	none	25	none	side ditches not deep enough, many filled up
Madison	1,100	1,100	950	34	all	none	
Montgomery	600	....	550	....	....	....	.....
Morgan	1,000	385	385	10 brick 4½ mac.	all	none	....
Newton	634	600	333	none	300	30	....
Putnam	1,206 1,300	....	920	....	all	2	tile
Ripley	6,000	350	259	1 conc.	none	none	....
Shelby	1,000	....	500	4 conc.	none	none	....
St. Joseph	834	all	40	40	100	2	clay drain tile, also some trench drain tile where a 2 ft. ditch is insufficient
Tippecanoe	980	976	680	15	....	75	....
Vigo	850	450	425	25 bk., conc. & vibr.	2 or 3	5	6-in. tile
Iowa:							
Allamakee	1,100	35	none	none	150	none	none
Appanoose	1,008	200	none	none	4	none	.....
Beton	1,160	300	none	8½	300	5	5-in., 6-in., 8-in drain tiles
Bremer	864	5	2	none	125	15	tile drains
Buena Vista	1,100	170	135	none	none	all	tile drain
Cass	1,500	5	none	1½	none	none	....
Cedar	950	14	2.25	none	400	very little	clay tile
Cerro Gordo	1,074	75	4	21	....	260	tile drains (clay & conc.)
Chickasaw	1,100	1,000	50	.....	1,050	120	tile drains
Clay	1,000	205	142	none	none	150	conc. or clay drain tile some surf. water inlet
Crawford	1,380	131	none	none	3	none	....
Dallas	1,100	70	48	none	1,000	300	6-in. drain tile
Delaware	900	600	30	none	none	20	tile
Des Moines	761.6	50	5	1 conc	almost all	15	farm tile
Dickinson	350	80	45	none	none	20	6-in. tile
Dubuque	1,000	50	30	4	....	.....	tile
Emmet	750	106	99	none	....	32	tile
Floyd	1,000	35.50	20.16	11.56 conc.	.....	40	tile
Grundy	1,000	300	6	none	200	15	tile
Guthrie	.....	.....	2	earth	.....	.....	vit. tile
Hamilton	1,000	91	90	none	10	300	6-in. tile
Harrison	170.5	14	none	none	.....	none	.....
Iowa	1,225	730	none	none	78	16	tile drains
Johnson	1 100	800	none	none	500	.....	.....
Kossuth	1,800	50	13.5	none	100	50	tile
Linn	1,400	10	27	3½	1,200	30	6-in. tile
Lucas	800	100	none	none	100	none	none
Lyon	1	150	8	0	8	1	clay-tile-drains
Madison	1,130	1.50	none	none	all	.....	.....
Mahaska	1,100	400	none	none	1,000	60	tile
Marshall	.....	.....	5	.....	.....	1	6-in.-8-in. drain tile
Monona	1,368	7	none	none	166	none	.....
Monroe	500	10	....	.....	.....	.....	.....
Montgomery	990	15	none	.....	.....	.....	.....
Muscatine	742	32.80	10.08	0.4	111.57	.....	tiling
O'Brien	1,125	860	none	1 2 ft. below shldr.		25	5-in -24-in. clay & conc. tile drains
Palo Alto	822.36	160	14	2 conc. pav.	3	30	drain tile with numerous ditches
Pocahontas	115.7	21.4	63	.....	none	some in each mile	6-in. drains-tile
Sac	1,100	150	80	none	300	75	5-in.-12-in. tile drain
Scott	695	50	70	2 brick, ¼ base for brick	.....	15	tile drains
Tama	140	20	none	none	all	5	tile
Union	1 325	all	none	none	none	5	6-in. tile
Van Buren	700	200	none	none	all	1	6-in.-10-in. tile
Wapello	1,200	100½	none	none	4	5	tile drain
Warren	1,100	none	none	none	none	none	none
Webster	102	9	0.5	none	.....	15	6-in. tile w. intakes
Winneshiek	1,000	none	none	none	none	none	none
Worth	800	300	50	none	none	30	tile drains
Kansas:							
Allen	1,056.5	90%	42.5	0.92 conc.	none	none	.....
Anderson	1,152	all	18	none	all	none	.....
Atchison	928	all	6	3½	100	½	tile
Barber	1,115	400	12	....	none	none	.....
Barton	1,873	1,221	3	5¼	160	none	.....
Brown	1,159⅜	none	none	none	none	none	side ditches
Cherokee	1,185	1,000	130	.....	all	none	side ditches
Crawford	1,190.58	all	28	none	1,140	none	.....
Elk	1,000	700	20	.....	700	.....	.....
Ellsworth	121	all dirt surfaced	....	....	.....	.....	.....
Finney	1,050	325	5	10 sand clay	none	none	.....
Geary	630	370	10	8 conc., 2½ brick	5	none	.....
Graham	1,400	300	none	none	200	none	culverts
Greeley	250	80	none	none	none	none	none
Harper	180	all	25	none	none	none	.....
Johnson	1,020	all	25	100	.....	short stretches	tile
Kingman	1,500	216	none	30 sand clay	6	none	.....
Labette	1,400	210	20	none	60	none	.....

ROADS UNIMPROVED, IMPROVED, AND DRAINED—(Continued)

County and State	Total miles of public roads	Miles graded	Macadam or gravel	Other kinds of improved surface	—Miles drained by— Deep side ditches	Underground drains	Kind of drainage
Kansas (continued):							
Lyon	240	200	2	1 conc.	20	none	.....
Marion	1,700	100	none	none	none	none	.....
McPherson	1,869	1,400	6	dirt	all	none	.....
Meade	770	700	none	none	500	none	.....
Mitchell	1,132	700	none	1½ conc.	200	none	.....
Montgomery	1,275	1,100	19	3	175	none	none
Nemaha	1,460	500	.....	.....	10	.....	.....
Norton	1,501	500	none	none	all	none	.....
Osage	1,153	173	none	none	all	none	.....
Pawnee	1,936	1,[illegible]	2 gravel	none	all	none	.....
Russell	1,500	250	none	none	all	none	.....
Sedgwick	1,958.92	1,500	.....	46	207.7	.....	.....
Shawnee	986	250	50	10 conc.	250	2	catch basins & sewer tile
Smith	1,820	all temporary	none	none	nearly all	none	.....
Stafford	1,200	500	none	none	none	none	none
Wabaunsee	1,500	1,000	5	none	.....	none	.....
Kentucky:							
Allen	300	75	60	7 crushed stone	none	none	natural slope with medium ditch
Barren	1,300	500	200	none	none	none	none
Bracken	400	300	275	.....	.....	.....	ordinary
Daviess	750	107½	104	1 rock asp.	none	none	none
Fleming	700	350	300	none	700	none	.....
Gallatin	250	155	155	none	200	none	none
Hopkins	670	23 graded	mac.	9 cinder	all	none	.....
Mason	400	300	300	.....	150	.....	.....
Montgomery	300	130	130	none	100	none	.....
Morgan	1,200	3	none	none	25	.....	.....
Oldham	250	200	125	.....	100	.....	.....
Owen	600	400	400	12 surf. treated	.....	none	.....
Pike	310	15	.....	.....	all	none	.....
Rockcastle	500	48	12	none	none	none	.....
Shelby	450	500	450	20	500	none	.....
Whitley	400	83	10	none	83	none	stone & concrete culverts, pipe culverts
Louisiana:							
Avoyelles	600	100	35	.....	100	.....	.....
Caldwell	150	85	7	none	85	none	corrugated & V.C. pipe; concr. culverts
Maine:							
Knox	3,000	50	10	40	50	none	.....
Maryland:							
Kent	425	200	3 gravel 20 mac.	16 conc.	none	few	4-in.-6-in.underdrain
Massachusetts:							
Athol	140	40	10	.....	.....	.....	tile
Michigan:							
Alger	300	200	35	earth	none	none	.....
Cass	1,600	250	175	7	none	none	.....
Dickinson	150	80	80	.....	none	none	none
Eaton	1,200	250	230	none	1	2	tile drains
Emmet	800	.....	27	25	.....	none	.....
Grand Traverse	.....	100	gravel	very few	.....	.....	.....
Kalkaska	200	180	100	5 stone	none	none	.....
Lapeer	.....	.....	100 gravel	none	.....	.....	.....
Luce	350	120	37	.....	9	.....	.....
Macomb	1,300	300	266	34	4	1	12-in. 18-in. vit. pipe
Mason	300	220	190	none	6	none	.....
Missaukee	685	some on all	138	.....	3	.....	open
St. Joseph	.....	78	78	.....	.....	.....	.....
Minnesota:							
Aitkin	260	200	49 gravel	.....	100	none	.....
Big Stone	436	400	30	none	none	none	.....
Blue Earth	200	111.5	89	8.5 oiled	25	40	clay & cem. tile dr.
Brown	900	all somewhat	150 grav.	none	200	none	.....
Carlton	700	400	96 gravel	6 sand clay	.....	.....	.....
Carver	240	40	40 gravel	.....	40	none	.....
Chippewa	960	300	50 gravel	none	10	100	tile, cement, clay
Chisago	850	200	87	none	100	19	6-in. tile
Cottonwood	1,300	500	35	.....	50	none	cross tile drains
Dodge	906	.....	66	none	none	none	.....
Faribault	1,200	120	21	none	indef.	10	cement & clay tile
Goodhue	900	100	60	5 conc.	.....	.....	.....
Grant	110	60	30	none	60	2	tile drains
Hubbard	.....	150	none	top soil	3	none	.....
Isanti	750	4.5	38.5	none	.....	.....	.....
Jackson	1,364	100	25	none	100	15	clay & conc. tile
Kandiyohi	1,200	75	50	4 conc.	none	9	6-in. tile drains
Lac Qui Parle	1,300	.....	125	.....	300	.....	.....
Lincoln	1,000	150	52	none	all that is graded	none	.....
Lyon	1,620	420	117	none	200	.....	.....
Marshall	.....	100	45	.....	15	.....	.....
McLeod	800	141.75	141.75 grav.	.....	8	4	tile
Millelacs	123	99	67	2 mac.	99	none	none
Nicollet	745	500	400 gravel	none	.....	10	conc. tile
Nobles	.....	90	50	6	80	4	tile
Pope	1,200	90	70 gravel	none	.....	.....	tile
Redwood	345	220	190	none	2	2	clay & conc. tile
Roseau	2,623	130	41.5 gravel	3.5 sand clay	130	none	.....
Stearns	2,100	1,000	500	.....	.....	.....	.....
Steele	500	300	200 gravel	none	none	none	none
Stevens	1,533	97.1	16.84 gravel	5.599 conc.	none	none	.....
Swift	1,500	300	80 gravel	7.4 conc.	75 by drainage ditches	60 tile drains	tile drains
Wadena	600	.....	3 gravel	3 sand clay	25-30	none	.....
Winona	650	125	45.2 mac. 52.3 gravel	14.9 conc., 3.2 brk.	100	none	.....

ROADS UNIMPROVED, IMPROVED, AND DRAINED—(Continued)

County and State	Total miles of public roads	Miles graded	Macadam or gravel	Other kinds of improved surface	—Miles drained by— Deep side ditches	Underground drains	Kind of drainage
Mississippi:							
Adams	237	38	34	none	none	none	1 in deep
Benton	300	11.8	none	none	1	none	
Lafayette	700	200	4	none			
Lincoln	500	160	160	none	none	none	
Lowndes	1,000	750	300	75 sand clay	750	750	D.S.C.V pipe tile iron pipe
Missouri:							
Butler	750	400	none	none	many	none	various
Caldwell	800	all	none	5 with oil	all factory well drained	none	
Carter		37	none		37	none	
Cedar	200	100	25	none	125		
Clark	400	100	none	none	none	none	grader side ditches
Cooper	1 100		150	none			
Henry	1 640	800	none		all those drained		
Lincoln	1,256	485	170	none	none but good grading	none	none
Macon	816	all partially some fairly well	none	dirt	all shallow	none	none
Mississippi	515	200	none	5½	200	70	tile
Monroe	1,000	all somewhat	30	none	½	none	
Ozark	800	100	none	none	none	none	
Perry	950	400	225	none	500	none	
Putnam	400	all to some extent	none	none	none	none	natural drainage
Ralls	900	all	50 gravel		150		
Schuyler	625	all	none	none	all	none	
St. Clair		500	4		all		
Sullivan	1,200	small amt.	none				
Montana:							
Beaverhead	1,200	700	10	none			side ditches culv.
Big Horn	662	408	7 gravel	none	all	none	
Blaine	1,200-1,300	500	40	none	60	none	
Carbon	1,500	200	26	2 cinder	20	none	
Chouteau	6,000	1,200	none	none	1,200	none	
Fergus	4,500	600	12	½ conc.	612	none	
Flathead	2,000	500	80		80	none	surface
Granite	350	150	20	none	20	none	
Hill	800	200	15 gravel	none	20	none	
Madison	1,100-1,400	240	15	none	20	none	ditches made by blade grader
Meagher	620	206	39	none	5	none	
Musselshell	1,500	1,000	1	1 cinders	none	none	side ditches with drains, culverts. conc. pipe
Prairie	640	220	27 gravel	none	none	none	
Stillwater	1,100	500	1	none	none	none	
Teton	805	200	25	none	none	none	
Valley	2 800	250	3.3	none	none	none	
Wheatland	350	175	10				
Yellowstone	2,500	1,800	50 gravel	2 conc. most of grad. rd.			
Nebraska:							
Antilope		500	3 gravel	none	100	none	open ditches
Dakota	560	125	none	none	125	none	
Deuel	co. is 15x31½	412	21-22 grav.	none	none	none	none
Dodge	1,080	1,064	10 gravel	6 paved			
Hooker	55	14	9	10	1	none	open ditches
Knox	1,500	1,000	2	none	50	none	
Morrill	200	75	gravel	none	50	none	
Otoe	1,300	900	none		125		
Rock	500	25	none	5	20	none	ditches
Saline	1,100	60%	none	none	10%	none	open ditches
Sherman	200-300	100	none	none	100	none	
Wayne	900	600	none	dirt	50%	10	8-10 in. drain tile
New Jersey:							
Burlington	1,500	350	200	50			
Cumberland	700	600	1½ mac.		none	none	
Hunterdon	1,000	100	80	8 pen. mac.	none	several mi.	French drains
Mercer		150	133	15	135	25	French drains, tile drains
Passaic	211	all	155	56		2	French drains
Southern Division	220	205	130	15 bit., 60 conc.	none	10	French drains
Sussex	950	80	80	none	15	30	stone, & 6-in. tile and stone
Union	797	700	235	119	none	10	4-6 in. pipes, 30 in. deep, in stone filled trench
New York:							
Broome	1,250	all	75	5	20		tile
Cayuga	1,490	75%	mac. 160-15 conc., 90 bit., gravel 300	15 mac.		small sections	tile & French drains
Chenango	1,746	1,746	105	65	1,500	25	4-6 in. tile
Franklin	135						
Jefferson	2,200	600	500	100	60	none	
Madison	1,422	1,422	275		400		
Monroe	1,330	1,330	1,038 mac., 244 gravel	8			
Nassau	90	70	46.65	18	2	none	none
Niagara	934	800	24 brick, 85 conc., 150 oiled, 200 W. B. & stone	30 gravel	nearly all	1½	farm tile
Orleans	720	720			720	none	
Oswego	1,714	900	337	425	none	none	
Otsego	2,251.50	200	146.75	13 conc., 2.01 Top.			
Yates	769	600	20	10	700		3-in. tile

ROADS UNIMPROVED, IMPROVED, AND DRAINED—(Continued)

County and State	Total miles of public roads	Miles graded	Macadam or gravel	Other kinds of improved surface	—Miles drained by— Deep side ditches	Underground drains	Kind of drainage
North Carolina:							
Beaufort	1,400	800	none	10	.....	none	.....
Buncombe	400-500	150	75	35	all that is graded	none	.....
Craven	200	100	10	50 brick	.....	.....	.....
Durham	800	200	109	20	.....	none	.....
Lenoir	120	40	none	12 asp.	25	5	tile
Randolph	1,500-1,750	500-600	350 grav.	none	.....	10-25	tile & metal
Washington	200	200	none	50 sand clay	30	none	shallow causeway ditches
Watauga	200	50	none	none	.....	.....	.....
Wayne	1,200	500	50 gravel	300 sand clay	.....	.....	.....
Wilkes	450	250	none	110	.....	.....	side ditches & drain tile
Wilson	700	200	16 mac.	90	all shallow	none	.....
Yancey	700-800	40	2	none	12	none	.....
North Dakota:							
Barnes	.....	500	10	none	125	none	.....
Grand Forks	1,000	500	40 gravel	none	150	none	triangular & flat bot. ditches
Grant	500	200	5	none	10	none	.....
McIntosh	.....	20	none	none	20	none	open
McKenzie	1,800	100	none	none	20	none	.....
Mountail	3,060	500 dirt	none	none	.....	none	corr. metal culvs.
Pembina	1,100	half	none	.....	50	none	open drain
Pierce	.....	50%	50	6 clay surface	10	none	none
Ward	2,700	100	10 gravel	none	none	none	none
Ohio:							
Allen	970	all	900	5 brick, 11 mac.	all, but not very deep	300	clay tile
Ashtabula	1,280	....	35.6 mac., 60 gravel	100	.....	.....	tile
Carroll	900	18	12	6	.....	none	side ditches
Champaign	800	700	700	25	.....	.....	.....
Clark	878	all	720	158	60	4	farm tile
Clermont	990.04	569.75	420.25	1.04 conc.	none	none	none
Clinton	758	700	620	3	5	none	.....
Columbiana	1,251	10	62.87	72.79 brk., 1081 conc.	50	none	.....
Coshocton	1,265	26	12.5	13.5	none	none	none
Darke	1,292.56	1,069.91	1,044.08	25.83	8	65	field tile in gravel in side ditch
Erie	1,116.30	400	41.2 gravel 248.30 mac.	30.70	8-10	.....	tile
Fairfield	1,000	....	700	5	all	.....	.....
Fayette	650	all	all	8 brick	all 1 in. to 2 in. deep	none	.....
Fulton	882.88	882.88	323.88	½ brick	.....	.....	.....
Henry	972	417	597.25	none	all	.....	tile
Highland	1,077.1	560.98	182.03 mac., 330.59 gravel	3.5 marl.	100	none	.....
Holmes	1,000.74	39.89	15	7.55	39.89	none	.....
Jefferson	1,019	650	245	20	.....	none	.....
Licking	1,410	400	425	26	150	2	tile & French drns.
Marion	787	....	500	1 brick	501	.....	.....
Meigs	999.6	60	4.75	16.20	1	.....	open ditches
Ottawa	595	95%	200	12 conc., 8 brick	100%	.....	.....
Pickaway	802	639.6	22.9	5.3	.....	.....	.....
Putnam	1,111.2	....	587	1 conc.	.....	900	tile
Richland	1,310	800-900	244	3 brick, 6 conc.	130	4,100 lin. ft.	field tile
Ross	1 093	....	....	.....	.....	.....	.....
Sandusky	950	900	503	42	500	200	clay tile
Summit	870	all dragged	16	58 brick, 36 conc.	.....	.....	tile, with cinder or gravel
Trumbull	1,171	450	350	40	300	14	tile
Tuscarawas	1,322	200	102.6	47.74	.....	.....	.....
Union	828	all	661	6½	all	75	drain tile
Warren	789	....	20 mac.	2.48 conc.	none	none	side ditches
Williams	953	900	144	9	500	very little	ditches or farm tile con. with catch basins
Oklahoma:							
Beckman	2,500	600	none	25 sand clay	100	none	.....
Bryan	2,500	200	none	.....	.....	.....	.....
Carter	1,600	600	37	none	.....	none	.....
Choctau	732	350	none	none	350	none	.....
Craig	1,115	....	2	.....	all	none	.....
Dewey	1,513	200	none	none	25	none	.....
Garfield	2,100	5,000	none	7 conc. & asp.	all	none	.....
Grady	2,200	175	none	none	.....	.....	.....
Hughes	1,480	148	none	none	148	none	.....
Kingfisher	1,845	228	1 conc.	16 sand clay	.....	.....	side ditchces -1-5 ft.
Latimer	300	75	5 gravel	.....	.....	none	culverts
Leflore	1,500	200	5 gravel	.....	.....	none	culverts
Major	271	214	none	64	51	none	.....
Oklahoma	700	300	3	150	very few	.....	culv. where needed
Pottawatomie	1,700	210	none	none	none	none	none
Oregon:							
Lake	1,300	500	16 crushed rock & gravel	200 gravel	80	350	metal culverts
Marion	1,250	900	700	40 asp. conc.	900	.....	cross drains of conc. & wood
Morrow	1,000	79	33	none	79	cross culverts	ditch & culvert, iron & conc.
Multnomah	500	500	250	100	.....	.....	.....
Polk	300	200	200	16-20 hard surface	.....	.....	.....
Sherman	550	250	54½	none	all	none	cross drns. & culverts
Wheeler	310	50	8	20	50	none	.....
Yamhill	....	....	250	14 conc., 11 bit	none	10	tile

ROADS UNIMPROVED, IMPROVED, AND DRAINED—(Continued)

County and State	Total miles of public roads	Miles graded	Macadam or gravel	Other kinds of improved surface	Miles drained by—Deep side ditches	Miles drained by—Underground drains	Kind of drainage
Pennsylvania:							
Armstrong	...	...	14	8	none	...	4 in. vit. tile
Erie	1,671	...	10-20	70 conc. & brick	....	....	tile underdrain-ditch, filled with gravel
Monroe	750	100	35	25	some	...	.....
Potter	500	...	12 mac.	dirt	mostly all	none	.....
Warren	...	...	...	20	...	...	conc. tile
Rhode Island:							
Bristol	55	20	2 topeka, 3 tarvia	20	15	5	storm sewers & open throat
Providence	75	all	all gravel	none	all	none	.....
South Carolina:							
Greenwood	2,200	260	none	117	40	20	4-6 in. farm tile
South Dakota:							
Clay	198	70	....	....	15	...	.....
Codington	1,280	626	15 gravel	none	90	none	.....
Corson	8,200	150	none	none	150	none	.....
Custer	600	15	2 crust. rk.	...	..	...	metal culverts
Davison	864	200	10 gravel	none	...	few places tiled	.....
Day	1,500	150	8 gravel	none	300	none	none
Gregory	225	200	1 gravel	5 clay on sand	50	none	.....
Haakon	500	200	none	none	....	none	.....
Hanson	856	10 grade	none	none	none	various places on private ditches	tile
Jackson	500	200	none	none	none	none	none
Lincoln	1,600	200	20	none	..	5	tile drns. cem tiles
McCook	1,200	200	10	none	15	none	.....
Miner	1,100	150	11½	none	140	none	.....
Minnehaha	1,500	65	65 gravel	none	none	none	.....
Perkins	500	158	none	..	none	none	culverts
Spink	3,200	half	none	none	not much	none	none
Stanley	140	200	none	none	....	none	.....
Tripp	3,500	500	none	none	.....	.....	.....
Union	250	none	none	none	none	none	.....
Walworth	870	275	none	none	none	none	open ditches
Yankton	210	46	none	none	22	4	4 in. tile
Tennessee:							
Bedford, Coffee and Moore	600	150	50	none	none	none	.....
Benton	209	40	none	none	10	none	.....
Coche	800	25	115	none	50	140	metal & conc. culvts
Greene	1,500	437	256	none	none	none	.....
Hamilton	900	900	600	100	all	none	.....
Lewis	80	45	8	.....	....	...	metal & conc. culvts.
Lincoln	....	...	120	.....	....	.....	.....
McMinn	600	200	10 mac.	.....	....	.....	.....
Monroe	300	190	75	none	none	...	.....
Tipton & Lauderdale	1,100	all	none	none	30%	none	.....
Texas:							
Aransas	125	100	sand clay	none	none	none	little required
Bosque	1,500	800	30 gravel	none	800	none	none
Callahan	800	100	50	none	....	.....	conc. culverts, corr. & vit. pipe
Cameron	....	50	5	2 conc.	20	none	.....
Carson	250	half	none	none	all that are graded	none	.....
Colorado	821	100	100	none	50	none	.....
Dickins	256.3	138.5	54.5 gravel	14 sand clay	all	none	.....
Edwards	190	none	none	none	none	none	none
Fort Bend	500	200	18	none	31	none	.....
Gonzales	700	70%	70	none	all	.....	open ditches
Harris	1,500	1,500	350	...	200	none	.....
Johnson	600	200	10	none	....	none	none
Limestone	900	90	5	none	none	none	.....
Madison	300	50	....	....	20	.....	.....
Milam	900	750	254	none	none	none	none
Montague	2,000	120	56	none	175	none	.....
Robertson	500	300	210	none	drainage with ditches on grade	none	.....
Rockwall	800	100	2	none	....	....	.....
San Augustine	250	70	12	none	none	none	.....
Shackelford	350	100	16	none	30	none	.....
Tarrant	1,200	500	400	130	.....	....	.....
Trinity	200-250	150	none	...	none	none	.....
White	300	150	70	none	all	none	natural
Wise	400	144	55	10	107	none	.....
Vermont:							
Bennington	779	300	6 mac., 200 gravel	7	10	5	"V" shaped filled with loose stone
Orange	1,406	200	200	5	all drained	.....	loose jointed pipe in ditch filled with gravel & brok. stone
Windham	1,466	100	95% gravel	5 mac.	none	20	stone drains
Virginia:							
Augusta	1,200	350	190	.....	.....	.....	.....
Brunswick	300	200	none	200 soil	none	none	.....
Campbell	200	68	22 mac., 45 soil	1 conc.	all	68	D. C. pipe, corr. iron pipe, conc. culvert
Fairfax	1,000	100	72	8 conc.	all	none	.....
Nansemond	125	100	30	5	25	none	.....
Scott	200	200	45	.....	.....	200	cast iron pipe corrugated metal & clay
Washington:							
Adams	1,978	235	282	none	235	none	.....
Benton	2,100	1,500	200	none	20	none	none
Clallam	600	.....	gravel	.....	all	none	.....
Clarke	2,250	400	250	50 hard surface, 23 conc., 27 bit.	25	15	shallow side ditches & frequent pipe culvrts.
Grant	2,600	800	400	0.1 conc.	.....	.....	.....
Island	300	180	150	none	50	4	4-6 in. tile

ROADS UNIMPROVED, IMPROVED, AND DRAINED—(Continued)

County and State	Total miles of public roads	Miles graded	Macadam or gravel	Other kinds of improved surface	—Miles drained by— Deep side ditches	Underground drains	Kind of drainage
Washington (continued):							
Jefferson	200	50	150	none	none	5	6 in. tile, porous
Lincoln	3,100	300	210	none	.....	none	.....
Okanogan	1,700	1,200	120	none	.....	practically all	corrugated steel reinf. conc. pipe
Snohomish	1,000	720	600	120 conc.	120	.....	.....
Wahkiakum	110	50	50	none	nearly all	none	culverts on hwy. & armco galvanized
West Virginia:							
Boone	94	12	none	none	none	none	stone & conc. culvts.
Brooke	180	45	10	14	90	.....	.....
Cabell	.....	.....	.....	50 brick	.....	.....	.....
Calhoun	616	41½	none	none	.....	.....	.....
Hardy	700	150	5	none	200	.....	.....
Mercer	432	118	60	none	none	118	70% V. C. pipe, 30% galvanized
Mineral	700	25	5 gravel	4 conc. 12 bit. mac.	.....	96	corrugated iron, conc. vit. pipe, wood
Morgan	350	70	2	11½	70	none	.....
Nicholas	600	24	none	none	124	none	.....
Ohio	200	200	100	50	200	50	4 in. farm or vit tile in ditch under gravel, stone, etc.
Pocahontas	600	20	15	none	18	.....	vit. clay, galv. & cast iron
Randolph	1,500	50	12	5 conc.	1,500	none	none
Summers	500	43	1.9 mac.	½ brick, & conc.	.....	.....	side ditches 8 in. below subgrade 5 ft. out
Taylor	50	.....	.....	3½ brick	.....	none	not much
Wayne	94	46	½ slag	10 brick	94	all improved & parts of others	conc., V.C.P. & cor. met. culvs.
Webster	101	20	none	none	20	none	dry rubble masonry
Wetzel	1,220	562	11¼ mac.	3 conc. & brick	.....	.....	.....
Wisconsin:							
Adams	1,120	103	4	40	not deep	none	.....
Bayfield	.....	214	150	3 crushed rock	2	none	.....
Calumet	627	.....	450	5	.....	.....	.....
Dunn	2,000	1,300	20	15 clay	5	none	.....
Forest	375	198.7	.....	.....	6	1	vit. tile
Grant	2,000	150	75	2	200	.....	.....
Iron	124	100	17½ gravel	3 iron ore, 3½ sand clay	none	none	.....
Jefferson	1,400	150	150	3 conc.	.....	1	6-in. tile
Juneau	1,235	250	1 gravel, 35 mac.	35 clay	250	2	tile
La Crosse	360	260	15 bit.	185 mac.	none	none	.....
La Fayette	1,200	175	40	none	none	2	8-in. tile
Lincoln	850	600	250	none	600	none	.....
Natrona	900	400	11½ gravel, 5½ conc.	1 bit.	.....	.....	.....
Portage	250	150	40	75	150	1	rock drains
Riverside	1,509.9	43.7 mac.	105 gravel	1,254.9 dirt	none	none	shallow gutters
Sauk	.....	266	242	6 conc.	.....	4	6-in. tile
Trempealeau	1,250	350	150	10	5	4	tile drains
Vernon	1,620	300	10	20	.....	.....	.....
Waushara	250	100	50	30 mac.	10	5	tile & storm cross drains
Wyoming:							
Weston	400	100	none	none	all	none	.....

(*Continued from Page* 327)

One of the most important matters connected with road improvement is that of drainage, but very few states or counties have even approximated the amount of this kind of work that is desirable. In the latest report of the committee of highway experts appointed to determine general specifications for an "ideal section" of the Lincoln highway, it is stated that the committee with surpising unanimity declared "that the dangerous open ditch, at present found along the greater proportion of our country roads, shall go. The ideal section will be drained by catch basins and submerged tile under the earth shoulders." Of the several hundred counties reporting on the matter of deep side ditches, we find 76 per cent reporting such ditches. Some of these report both deep side ditches and the use of underground drains, about 34 per cent of the counties reporting the greater or less mileage provided with underground drainage, although 66 per cent report no use whatever of this method of draining out the road bed. There are, of course, considerable areas and possibly whole counties where little if any subsurface drainage is necessary, but anyone familiar with highway work throughout the country knows that on a considerable percentage of even the improved highways sufficient attention has not been paid to the subject of keeping the sub-grades dry. The last column tells briefly some of the methods, kinds and sizes of pipes, etc., used in draining roads.

These include double-strength vitrified pipe, vitrified clay pipe, land drainage tile, wooden boxes; "4-inch and 6-inch farm tile laid 3 feet to 4 feet deep on one side of the road"; gravel drains; French drains; "5-inch to 24-inch clay and concrete tile drains; catch-basins and sewer pipe"; 4 to 6-inch pipe laid 30 inches deep in stone-filled trench. Perhaps the majority report tile drains 4 to 8 inches diameter. For culverts various materials were reported, including concrete, rubble, tile, cast iron, corrugated, "armco," steel, galvanized and wood.

South Carolina Highway Department

Procedures adopted for making surveys and plans and for maintaining roads. General features of design.

Stimulated by the general country-wide enthusiasm for better highways and influenced in some cases by the requirements necessary for securing federal aid, practically all of the states now have state highway commissions. Several of these are entirely new features of the state government, while many others have been modified by adopting plans of organization and details of executive and administrative features that have been found desirable by experience of other states.

One of the recently changed highway commissions is that of South Carolina, which although created in 1916, was modified by an act approved March 10, 1920. The commission, shortly after that, appointed Charles H. Moorefield as its state highway engineer, his services beginning on July 1 of last year.

To comply with the state law and to insure the most effective development of state highways, it was necessary first to lay out a system of connecting highways throughout the state and to make surveys and plans for such work as was contemplated for immediate construction. This was done expeditiously and by December 31 contracts had been completed on 25 miles of hard-surface roads and 335.6 miles of gravel, top soil and sand-clay roads. In addition the bridge division had prepared plans for 53 bridge structures, of which 11 were completed during the year totaling 619 feet of reinforced concrete and 306 feet of timber. Contracts had also been let for 2,056 feet of concrete and steel bridges, 958 feet of reinforced concrete and 565 feet of creosoted timber.

SURVEYS AND PLANS

Every survey involved consideration of the probable future development of adjacent lands; type of surfacing to be used immediately and probable future type; surface drainage and subdrainage; connections with other roads; adjusting grades to existing bridges, railroad tracks, water mains, sewers, etc.; elimination of railroad crossings; avoidance of dangerous curves and excessive grades. In every feature, cost of construction was, of course, given serious consideration.

After making preliminary location, the actual staking out is begun. Stakes are set at each 100 feet and also at humps or noticeable depressions, on the banks of ditches and streams, etc. Curves in alignment are calculated and staked out. The position of property lines, nearby houses, railroad tracks, fences, canals, streams, telephone and telegraph poles, woods, etc., are noted and measurements taken so they can be shown on the plans. A sufficient number of stakes are referenced so that they can be replaced if disturbed.

Following this, levels are run and the right-of-way cross-sectioned for at least 25 feet on either side of the road limits. Following this a system of check levels is run, generally by an independent line of bench levels, and if discrepancies are found it may be necessary to run a third line of levels.

Each survey party is usually composed of three men employed by the state department and two furnished by the county. The chief of the party studies the route, selects the location, sees that the party sets the stakes at proper points, checks the calculations and notes made by the instrument men, makes recommendations as to proper sizes and location of culverts and bridges, makes a daily report to the office of the department, and arranges for board, lodging and transportation for the party. In difficult situations or in case of protest by property owners, he calls upon the chief of survey, and if the latter cannot adjust matters in the field he takes them up with the state highway engineer.

During 1920 the state department had from one to six survey parties operating. These parties surveyed a total of 370 miles of road in 20 counties at an average cost of $92.77 per mile. In addition, the completed plans, not including bridge plans, cost $61.30; making a total average cost of $154.07 per mile for surveys and plans.

The plans were prepared by the drafting division. For each road there was prepared plan-profile sheets and cross-section sheets, and detail sheets of all bridges and culverts except pipe culverts. Each sheet of plan and profile shows 3,000 feet of road. The plan is placed at the top of the sheet and shows all curves with their length and degree, the position of bridges, culverts, fences and other physical features, the name of property owners and their property lines, and the location of the old road and branch roads. The profile shows the elevation of the ground at each stake, elevation of bottoms of streams and ditches, sizes and elevation of culverts and bridges, both those to be left in place and those to be installed, the elevation of highest known water so far as this could be ascertained, and the grade elevation proposed for the finished road.

The cross-section shows the present ground surface at right angles to the survey at each stake and the outline of the proposed cut or fill. The area of the cut or fill is calculated and used for computing the volume of grading necessary.

The best record made by a draftsmen of the department forces in turning out completed plans was about 34 hours per mile of finished plan, this not including plans for bridges or culverts. There were several changes in the drafting room force but that employed during the year was equivalent to 16.2 men employed for the full year.

MAINTENANCE

The state had under maintenance during the year 411 miles of road, of which 6.9 miles was asphalt concrete, 4.0 bituminous macadam, 15.1 cement concrete, 4.4 gravel, 70.7 sand-clay, 309.2 top soil, 1 waterbound macadam. Part of these were maintained by the gang system and part by

patrol, 11 counties by the latter as against 31 by the former. $66,519 were spent, giving an average maintenance cost of $161.71 per mile.

The floating gangs were equipped with motor trucks, road machines, drags, etc., and were used either on unusually long roads or on several roads. The patrol organizations generally consisted of patrolmen who lived along the road on which they worked and who were equipped with a small road machine or road drag, small tools, etc., but furnished their own team and wagon. It is expected that the patrol system will gradually be extended over a large proportion of the roads under state maintenance. The funds received for state maintenance consist of 80 per cent of the motor vehicle licenses received from the several counties.

ROAD DESIGN

The department has not adopted inflexible rules for designing and constructing state roads, but endeavors to adapt each project to local conditions so as to get maximum value for funds expended. In general it aims to adopt road locations that will not need to be changed in the future under any traffic developments; to avoid and eliminate railroad crossings; afford adequate accommodations to traffic with respect to grades, width of roadway, sharpness of curbs, etc.; and secure the greatest practicable durability by effective drainage, possibility of proper maintenance and sufficient width of right-of-way.

In general, it has made the right-of-way not less than 50 feet wide; the minimum width of roadway 28 feet on embankment and 32 feet in cut; a minimum of 16 feet width of hard surfacing with 18 feet ordinarily; a limiting grade of 5 per cent for lengths of more than 600 feet and 6 per cent when the length is less than 600 feet and the view is open; minimum grade for side-ditches one-half of 1 per cent; maximum curvature of 12 per cent in rolling country, and in hilly and mountainous country such that a clear view ahead can be had for at least 150 feet, with curves sharper than 6 per cent banked and widened where hard surface is used. Surfacing is made 12 inches thick at the center and 4 inches at the edges for top soil; 10 inches at the center and 4 at the edges for sand-clay; 8 at the center and 6 at the edges for concrete; 6-inch concrete foundation for asphalt surface, 8 inches thickness for stone base, and 2 inches thickness of asphaltic concrete surfacing. In designing ditches and culverts in hilly country it is assumed that a 15-inch pipe will drain 3 acres, an 18-inch pipe 5 acres, a 24-inch pipe 8 to 10 acres, a 30-inch pipe 10 to 15 acres, and a 36-inch pipe 15 to 30 acres. In rolling and flat country larger areas can be drained.

Bridges are required to be designed so as to carry 2 to 15-ton trucks, have a width of roadway of 18 feet, and be built of either concrete, steel or creosoted timber, with a strong preference for the first. The unit strengths assumed are: for concrete, 650 pounds per square inch in compression; steel, 1,600 pounds per square inch in tension or compression, with the customary corrections for compression in long columns; creosoted yellow pine, 1,350 pounds per square inch; loblolly, 1,200 pounds per square inch.

State Work in 1920 and 1921

Figures giving the amount of highway work done in the several states last year and contemplated for this year, together with the money available for the latter. Also mileage of improved and unimproved roads in the several states.

Within the past few weeks we have received from highway officials of the several states replies to a questionnaire which we sent them asking: "Amount of each kind of pavement, number of bridges and other highway work completed by state forces or under state supervision in 1920." "Amount of such work contemplated in 1921." "Money available for state expenditure on highways in 1921." "Miles of improved and of unimproved roads in your state." "Changes made, for this year's work, in the specifications for road work that were in force in 1920." The data are tabulated on the following page.

These replies show that, in spite of the unfavorable conditions of last year, most of the states did quite a little amount of road work. However, the majority of them expect to do considerable more this year than they did last. As to the amounts available, these are seen to range, for individual states, from $1,400,000 to $60,000,000, totaling about $600,000,000. It is, of course, understood that these sums, while available, will in few cases be entirely expended this year; in fact, in many cases the sum mentioned is the total available for two years or more to come.

Many of the state officials did not pretend to have figures for the mileage of improved and unimproved roads. In such cases the figures given by us are those published by the Bureau of Public Roads and are presumably as nearly correct as it is possible to estimate them. These show about 10½ per cent of all the roads in the states classed as improved.

Not many of the states have made any radical changes in their specifications, but a few have done so. A discussion of these will be given in a later issue, there being insufficient space available this week for that purpose.

State	Amount of highway work done by State in 1920	Amount of such work contemplated in 1921	Money available for 1921	Miles of improved roads	Miles of improved roads in State
Alabama	19.54 asphalt, 29.02 gravel and chert, 86.45 sand clay, 3.19 grading. Concrete bridge. Total cost, $1,623,466.57.	7.1 asphalt, 18.8 gravel, 67.59 sand-clay, 65.1 bit. mac.	$4,000,000 to 5,000,000	7,800	5,[illegible]
Arizona*			[illegible]		
Arkansas	$397,500 earth, $7,050,000 gravel, $1,500,000 mac., $1,350,000 penetration mac., $2,767,500 asphaltic conc., $2,160,000 conc., $1,110,000 bridges—total cost, $16,805,000.	$4,000,000 earth, $9,000,000 gravel $2,000,000 mac., $2,000,000 penetration mac., $3,000,000 asphaltic concrete, $2,880,000 concrete, $1,-[illegible],000 bridges, total cost, $21,-760,00	21,760,000	5,000	45,000
California*	31 Topeka on conc., 427 conc., 34 oiled mac., 1 bit. conc., 280 grading (a).				
Colorado	20 concrete, 46 gravel, 54 grading.	28 conc., 100 gravel, 57 grading.	26,000,000 3,400,000	12,000	48,000
Connecticut	1.93 grading, 16.89 gravel, 12.57 mac., 6.28 bit. mac., 28 bit. conc., 3.74 conc., $94,330, bridges.	[illegible] shed work left.	8,000,000*	1,557	12,443
Delaware	11 penetration mac., 45 cement concrete.	56 uncompleted contracts, 40 mi expected to be let.	3,843,674	326	3,470
Florida*					
Georgia	52.0 paved, 93.9 sand-clay, 8.2 gradual eq.	242 paved, 841 sand-clay, 47 grading (b).	7,725,000 10,000,000*	8,000 18,200*	14,[illegible] 67,469*
Idaho	49 paved highways, 280 rocked & graveled rd., 300 earth, 7 bridges (a).		6,000,000b	1,400	23,600
Illinois	341 hard surf. rds., 56.77 grading, 30 bridges.	130 hard surfaced roads, 78 [illegible] grading & 51 bridges to be completed from 1920 work.	8,865,517	9,910	85,090
Indiana	6.04 bit. concrete, 12.696 concrete pavement, 2.44 reinforced conc., 2.66 2-course conc., 2.39 brick, 13 bridges—total cost, $1,032,183.26.	125 road and bridges plus 100 mi now under contract.	5,000,000	35,000	60,000
Iowa	16.6 paving, 105.5 gravel, 309.8 grading.	203 paving, 456 gravel, 1,860 grading	20,000,000	1,880	101,820*
Kansas	16.5 brick, 35.6 conc., 13.3 mac., 26.2 gravel, 23.8 earth.	38.2 brick, 94.8 conc., 24.8 mac., 45.0 gravel, 35.6 earth.	20,000,000*	1,640*	109,320*
Kentucky	101.2 earth, 52.1 gravel, 110.6 mac., 1.4 bit. mac., 13.4 rock asphalt, 6.7 concrete, 2.0 brick, 1.5 cinder, 100.1 surface treatment.	10 conc., 60 bit. or rock asphalt, 50 mac., 25 gravel, 75 earth, 50 other types	7,000,000	14,490*	42,438*
Louisiana*			6,000,000*	2,700*	21,863*
Maine	180 gravel, 18 bit. macadam.	235 gravel, 69 bit. mac., 60 conc.	5,000,000	3,525*	20,012*
Maryland	86.45 conc., 2.60 sheet asphalt, 1.48 sheet asphalt on mac. base, 6.50 mac., 19.38 gravel.	28 left from 1920.	7,600,000	3,235*	13,090*
Massachusetts*					
Michigan	204.23 gravel, 25.7 mac., 9.0 bit. mac., 9.5 b[illegible] surface, 10.7 conc., 8.8 bit. conc., 0.7 sheet asphalt, 0.4 brick.		8,000,000 35,000,000	9,100 10,870*	9,581 63,050*
Minnesota	59 concrete, 19 asphalt concrete.	About 100 miles.	25,000,000	7,080*	79,280*
Mississippi	42.1 earth, 2.8 conc., 142.1 gravel.		5,000,000	2,850*	42,700*
Missouri	415.7 earth grading, 145.2 gravel, 27.7 mac., 5.6 chert, 2.0 chats, 7.2 bit. mac., 2.7 warrenite (a).	95 bit. mac., 958 gravel, 54 mac., 47 brick, 108 conc. (b).	8,870,000	7,740*	88,100*
Montana	19.8 conc., 197.3 gravel, 75.3 grading.	41 conc., 1.4 bit., 555 gravel, 177.7 grading, 10 bridges.	5,200,000	500	59,500
Nebraska	6 1-2 brick, 8 conc., 55 sand clay, 23 gravel, 1,215 earth grading, $200,000 bridges.	50 paving, 60 gravel 1,200 earth grading. $200,000 bridges, $300,-000 culverts.	6,000,000	1,550*	80,000
Nevada	13.8 conc., 64.3 gravel, 89.0 graded, 6 bridges.				
New Hampshire	18.11 gravel, 12.40 crushed gravel, .52 earth, 6.41 grading, 1.05 bit. macadam, 2.51 mac., 4.93 asp.		1,380,000 2,500,000	200 1,500	1,900 13,500
New Jersey	98 miles.	69 miles.	16,000,000	6,050	8,767
New Mexico	109.4 gravel, 43.1 crushed stone, 24.1 grading, 18.9 concrete, 22.0 caliche (a).		4,000,000	1,960	47,607
New York	84.3 concrete, 64.9 bit. macadam, 23.5 macadam, 3.9 gravel.	At least 500 mi hoped for.	18,000,000	12,330	67,670
North Carolina			10,000,000	6,000	46,000
North Dakota	524 earth, 43 gravel.	835 miles	3,000,000	3,500	66,500
Ohio	36.2 brick, 12.9 bit. concr., 71.8 bit. mac., 35.0 pl. concr., 46.2 rein.-conc., 69.5 mac., 20.4 mac. surface treated.	6.6 bitoslag, 8.7 bitulithic, 126.5 brick, 17.4 bit. conc., 121.0 bit. mac., 163.6 conc., 58.3 grading, 24.3 gravel, 23.7 Kentucky rock, 144.5 mac., 8.5 sheet asphalt.	12,442,000	31,800*	54,554*
Oklahoma*					
Oregon	16.4 conc., 167.7 bit. conc., 275.0 mac., 474.8 grading, 107 bridges.		8,000,000 24,900,000b	700 5,000*	107,216 31,819*
Pennsylvania	325.6 reinf.-conc., 1.1 plain conc., 58.5 bit. top on conc. base, 17.4 brick, 1.9 sheet asp., 9.3 mac.	807 miles total.	35,000,000b	4,500	85,500
Rhode Island	2 mac., 12.9 bit. mac., 10.2 bit con., 1 conc., 0.5 sheet asphalt, 10 bridges.	7.1 mi. bit mac., 19.2 bit. conc., 1.3 concrete, 12 bridges.	1,400,000	1,250	1,125
South Carolina	25.1 hard surface, 335.6 gravel, top soil, sand-clay.	11.6 hard surface, 275.7 gravel, top soil, sand clay (d).	6,000,000*	3,800*	38,426*
South Dakota					
Tennessee	17.9 chert, 7.0 conc., 43.5 mac., 24.6 bit. mac., 5.8 rock asp., 36.2 grading		8,469,280 7,500,000	800 8,800*	95,506 37,250*
Texas	7.1 conc. pavement, 173.94 gravel, crushed stone w. bit. topping, 516.06 gravel or crushed stone, 169.93 sand clay or shell, 109.56 grading & conc., drainage structure, 5 bridges (a).	148.1 conc. pavement, 714.3 gravel or crushed stone w. bit. topping, 1,740.1 crushed stone or gravel, 149.2 sand-clay or shell, 744.1 grading & conc. drainage structures, 18 bridges.	60,000,000*	1 000	147,000
Utah*					
Vermont*			6,000,000	1,650	7,160
Virginia*			2,000,000	2,300	11,949
Washington	162.8 crushed rock & gravel, 53.4 conc., 2.0 asp. mac., 1.7 warrenite.		10,000,000 14,000,000*	6,150 1,945	47,238 44,850*
West Virginia					
Wisconsin	623 earth, 624 gravel, 126 top soil, 88 concrete.		6,000,000 27,514,487	1,600* 15,500*	30,424* 61,750*
Wyoming	70 conc., 1.1 bit., 80 gravel, 700 earth	245 concrete and others. 43 conc., 100 gravel, 300 earth	3,000,000*	600*	14,197*

(a)—Includes 1919 and 1920. (b)—Includes 1921 and 1922. (c)—Total completed to date. (d)—Under contract.
* Information not furnished by state officials but derived from o[illegible]rces.

NEWS OF THE SOCIETIES

April 18-23 — UNITED STATES GOOD ROADS ASSOCIATION. Greensboro, N. C.

Apr. 19 — CLEVELAND SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

April 21 CINCINNATI SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with Engineers' Club of Cincinnati.

April 21-22—BANKHEAD NATIONAL HIGHWAY ASSOCIATION. 5th annual convention. Greensboro, N. C. Secretary, J. A. Routree, Birmingham, Ala.

April 22 — METROPOLITAN SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with American Institute of Electrical Engineers.

April 22—BIRMINGHAM SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with Atlanta, Birmingham and New Orleans sections, with members of Council present. Battle House, Mobile, Ala.

Apr. 25 CHICAGO SECT., AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Joint meeting with ELECTRICAL AND MINING SECTIONS, WESTERN SOCIETY OF ENGINEERS and ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS.

April 27—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention. Houston, Texas.

Apr. 27-29—BUILDING OFFICIALS CONFERENCE. Cleveland, Ohio.

Apr. 27-29—SOCIETY OF INDUSTRIAL ENGINEERS. Milwaukee, Wis.

April 27-29—UNITED STATES CHAMBER OF COMMERCE. 9th annual meeting. Atlantic City, N. J.

April 27-29 — BUILDING OFFICIAL'S CONFERENCE. Seventh annual meeting. Cleveland, Ohio.

April 28-29—MID-CONTINENT SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting of Chemical Eng. Societies. City Auditorium or Convention Hall, Tulsa, Okla.

April 29 — EASTERN NEW YORK SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Edison Club Hall, Schenectady.

April 29 — COLORADO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Metropole Hotel.

Apr. 29—SAN FRANCISCO SECTION AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

May 2-4—MISSISSIPPI VALLEY ASSOCIATION. 3d annual convention. New Orleans, La.

May 4-7 — NATIONAL FOREIGN TRADE CONVENTION. 8th convention. Cleveland, Ohio.

May 6 — VANCOUVER SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

May 9 — HARTFORD BRANCH AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Get-together dinner at City Club.

May 9-11 AMERICAN ASSOCIATION OF ENGINEERS. 7th annual convention. Buffalo.

May 9-12—SOUTHWEST WATER WORKS ASSOCIATION. Shirvin Hotel Headquarters, Oklahoma City, Okla.

May 10-12 CANADIAN GOOD ROADS ASSOCIATION 9th Annual convention. Halifax, Can. Secretary George A. McNamee, Montreal.

May 17 CLEVELAND SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual dinner.

May 17-19—NATIONAL FIREMEN'S ASSOCIATION. Twenty-third annual convention. Fort Wayne, Ind.

May 19 — SAN FRANCISCO SECTION AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

May 20 — AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. 370th meeting. Engineering Societies Building, New York City.

May 20 — PHILADELPHIA SECTION. AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Annual dinner, Hotel Adelphia Roof.

May 21 — ATLANTA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with ATLANTA SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

May 23-26 — AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Spring meeting. Congress Hotel, Chicago.

AMERICAN ASSOCIATION OF ENGINEERS

The seventh annual convention of the American Association of Engineers will be held in Buffalo May 9 to 11. New officers for the ensuing year will be elected.

Educational work of engineers within the organization to establish closer contact with the management and to prepare men for high executive positions was begun at a meeting held on March 24 in an Illinois Central office building, Chicago. Mr. C. C. Haire, presided. The Illinois Central section of the American Association of Engineers consists of 125 railroad professional engineers.

The Washington office of the American Association of Engineers, A. T. Koehler, district secretary, has been moved to Chesley building, 1317 New York avenue, N. W., Washington, D. C.

The Detroit Chapter in co-operation with the Detroit Board of Commerce has arranged for a lecture by Hon. Harry M. Fisher, judge of the Municipal Court of Chicago, at the Board of Commerce auditorium in Detroit on March 26.

Judge Fisher went abroad as chairman of the Ukraine Commission for the Joint Distribution Committee of America for Jewish sufferers. His lecture in Detroit will be based on his observations and findings in that country and will be entitled "The Truth About Soviet Russia."

THE FEDERATED AMERICAN ENGINEERING SOCIETIES

Gratifying progress is being made by the Federated American Engineering Societies. Permanent offices have been set up, the work of organization is developing rapidly, and there has been much constructive activity in legislation. A statement by the executive secretary, L. W. Wallace, says:

"Permanent headquarters of the Federated American Engineering Societies have been established in Washington on the third floor of 719 Fifteenth street, N. W. (National Savings & Trust building). Sufficient space has been obtained to provide a large lounging room or conference room for those who may desire to use the headquarters as a meeting place. It will be the purpose of the headquarters at all times to render as much personal service as possible to engineers who visit Washington.

A special plan will be developed to the end that engineers visiting Washington may be able to transact business with the minimum amount of effort on their part. Engineers, therefore, are asked to notify it of an intended visit to Washington so that arrangements may be made to care for them. The executive secretary will be permanently located in Washington in the near future.

There is great activity in a number of states regarding the licensing of engineers. The F. A. E. S. has in every instance taken a part in such legislation. It has made an effort to have a representative at every meeting. It is not the desire of the F. A. E. S. to initiate such legislation nor to urge its passage, but it does take the position that it desires to be instrumental so far as possible towards securing the passage of a bill that will not be detrimental to public interests and to the engineering profession.

The Patents Committee has considered a congressional bill that will provide more adequately for the Bureau of Patents. It has sent out a request that influence be brought to bear upon Congress for the establishment of better support for the Bureau of Patents. Member-societies and others have responded with a fine spirit of cooperation.

A careful study is being made by the Employment Service to determine what policies should be adopted that will enhance the value and usefulness of the service to the individual members of the member-societies. This report will be submitted to the executive board at its meeting on April 16.

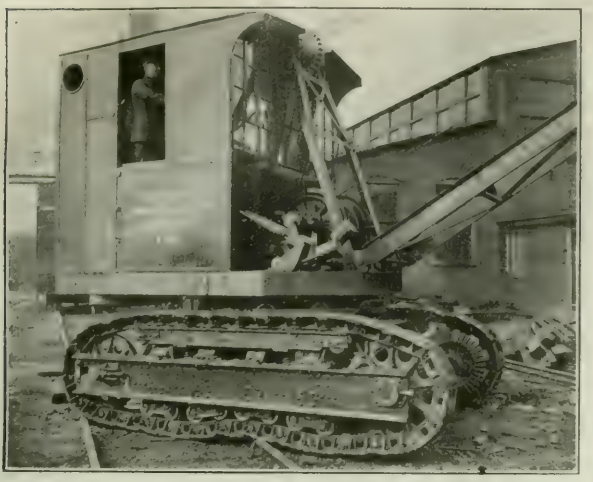
The work of the Committee on Elimination of Waste in Industry is progressing according to schedule. The field work will be completed on or before April 15. The final report will be published in June. The findings of the committee thus far are very significant and it has every reason to believe that the publication of this report will create a great deal of interest.

There is a large interest on the part of engineering societies that have not yet become affiliated with the F. A. E. S. In recent weeks two have joined, namely, The Boston Society of Civil Engineers and the Engineering Society of Milwaukee. There are a number of other societies that are either voting upon it at the present time or have it under consideration by the executive boards. It is reasonably sure that a number of other societies will become affiliated with the A. F. E. S. before July 1, at which time the opportunity of coming in as a charter member will expire.

The last meeting of the executive board was held in Philadelphia on April 16. The executive board were the guests of the Philadelphia Engineering Club and the sessions were held at the Engineers' Club. The club made preparations for a large attendance which duly materialized. There was a dinner at the Bellevue-Stratford on the evening of April 16 which was addressed by the president, Mr. Hoover.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



CRAWLING TREAD LOCOMOTIVE CRANE DEVELOPED FROM MILITARY TANK TYPE OF TRACTION

A NEW CRAWLING TREAD CRANE

One of the latest crawling tread cranes developed is the OS Dependable, manufactured and sold by the Orton & Steinbrenner Co. Two sizes are made, both especially adapted to contractor's use; they are rated as 7 tons and 12 tons capacity.

The crawling tread is an improved form of that used on government tanks during the European war. The tread links and sprockets are of cast steel and the chain idler rollers are bronze bushed with patented pressure system of lubrication. Each crawling tread is supported on bottom between drive sprocket and idler by four pairs of idler rollers. Each pair is carried in and equalizing strut backed by heavy coil spring and when traveling over obstacles will tilt as much as 6 inches from the horizontal. It will travel up grades of 20 to 30 per cent in soft material.

Tread link ends overlap and no foreign material can enter the spaces between, thereby eliminating the principal difficulty experienced heretofore in machines of this type. Surface area of crawling tread is great enough to reduce unit pressure on ground to 10 pounds per square inch, although crane weighs in the neighborhood of 4,500 pounds.

The sprocket is driven by steel bevel gears and no chain drive is used. The hoisting mechanism is designed mainly with a view to accessibility and consists of four main horizontal power shafts driven through a train of cast steel cut spur gears and three auxiliary vertical shafts driven by cast steel bevel gears. Any one function may be operated independently of the others or all may act together.

For operating a bucket, double automatic drums are regularly supplied, thus doing away with one set of levers, and increasing simplicity of operation. Frictions are of large diameter and made of bronze; no wood friction blocks are used. The large braking surfaces insure quick action in lifting and releasing the loads and minimize wear. The crane can be turned completely around in a radius about equal to its own length. In addition to clam-shell or orange-peel bucket, pile driver attachments, derrick hoists and drag-line equipment can be operated.

The standard 7-ton crane is equipped with a 30-foot boom. The standard 12-ton is equipped with 35-foot boom and extra lengths may be supplied. Broad-faced road wheels or standard or special gauge rail tracks can be furnished besides crawling tread.

PIPE CUTTING MACHINES

The pipes and tubes manufactured by the Box Machine Company are illustrated on detachable pages that can be inserted in a filing cover, furnished for the purpose. They can be furnished either geared or belt driven. The number 10 cutter is mounted on a cabinet pedestal and has a capacity for cutting ⅜-inch pipe in 2 seconds and 6-inch pipe in 1 minute 43 seconds. The cutter discs are 6 inches in diameter and are provided with an oil pump and with a grinding attachment.

OVERLAND CRANES

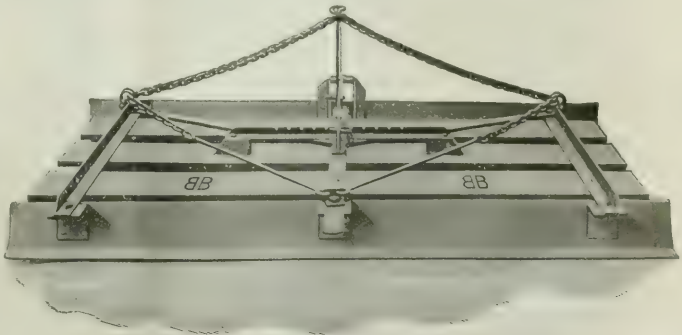
Overland cranes manufactured by the Overland Crane Company are recommended for simplicity in design, small number of parts, differential drive, accessibility, and unusual strength.

They are full-revoving ¾-yard, 5-ton capacity with a 30-foot boom and are suitable for road building, contractors' use and erection purposes.

B B REVERSIBLE ROAD DRAG

The B B reversible road drag made by the Bayne Manufacturing Company, embodies four special and important features; namely, the reversal or change of angle of the drag by means of a rear lever that controls it without danger to the operator; the maintenance of the rear troweling blade always in the trail of the front cutting blade, thus keeping the drag always at the same width; the curvature of the rear blade to form a trowel that tracks, puddles and trowels the surface to a hard, tough, smooth roadbed, and the excellent service for opening and cleaning the ditches at the roadside.

It is easily handled by one man and two horses and can be pulled straight ahead as a leveler or smoother or can be used to transfer the earth from the edge toward the center to crown the roadbed. The most important feature is the rear hitch that permits the drag to adjust itself to any reversing angle and insures the travel at the rear blade in the trail of the front one, which is particularly valuable for cleaning roadside ditches.



REVERSIBLE ROAD DRAG WITH COVERED REAR BLADE

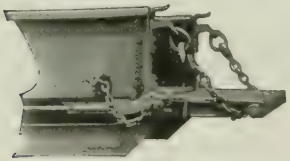
MURDOCK ANTI-FREEZING BUBBLE-FONT

The anti-freezing bubble font, manufactured by the Murdock Manufacturing & Supply Co., is designed for use in streets, parks, playgrounds, school grounds, semi-exposed and uncertainly heated enclosures and is claimed to be unfreezable, indestructable, automatically drained, anti-contagious, and non-spurting. It is self-closing; all of the inner parts are accessible or removable by removing two pedal and two top bolts. It has an adjustable lock regulating device, a protecting air jacket, and is held rigidly in place by a heavy bronze spring.

HEIL DUMPING EQUIPMENT

Dumping units manufactured by the Heil Company include a variety of steel bodies, hydro-hoists and tail gate devices that are maintained in stock suited to several styles of chassis shown in bulletin 115. They are all thoroughly tested and guaranteed and are made by modern machinery in a plant with a new 35,000 square foot addition.

The road work body is square cornered and straight sided, permitting boxes, boards, packages, blocks, tiles, bricks, etc., to be piled closely. Dumping is promoted by the fact that all bodies are made 3 inches wider at the rear than in front, thus facilitating the discharging of wet sand or concrete.



DOUBLE ACTING TAIL GATE

Bodies are fitted with single acting tail gates or with double acting tail gates, hinged at both top and bottom to enable the gate to lay down level with the floor. The tail gates are opened by a manual device having goose neck hooks attached to the body and operated by a lever easily accessible from the driver's seat.

Heavy road work bodies are supplied with a chain fender device to regulate the position of the gate and the thickness of the layer of crushed stone and spread it uniformly when dumped.

The hydro-hoist that can be used on any dump truck is mounted under the body and utilizes all the loading space back of the cab. It permits a short wheel base and is lighter than any other under-the-body hoist and eliminates all cables, pulleys and rollers. It is self-contained, with a tank communicating directly with the cylinders, and the pumps are operated to make the oil serve as a cushion. Its lifting power

HYDRO-HOIST FOR DUMP BODIES

is unlimited and it can dump with one rear wheel lower than the other.

Heil dumping equipment has been adopted by many state and county highway departments, some of which have about 200 units in operation.

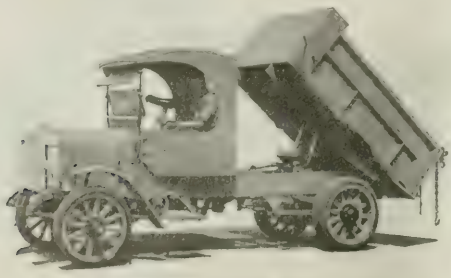
C. M. B. SERVICE BOX

The service boxes for street mains, manufactured by the H. W. Clark Co., have a heavy cast iron base to enclose the valve that is slotted at opposite ends to engage and center a service pipe. The upper part is constructed of a heavy cast iron pipe, in which a telescopic top section moves vertically to permit displacement by frost without moving the bottom portion. The top of the telescopic pipe is closed with a screw cap and is provided with a transverse vertical pin to prevent accidental turning. It is made in 18 sizes from 1 inch to 9½ inches and with adjustments of from 1 foot to 10½ feet in length.

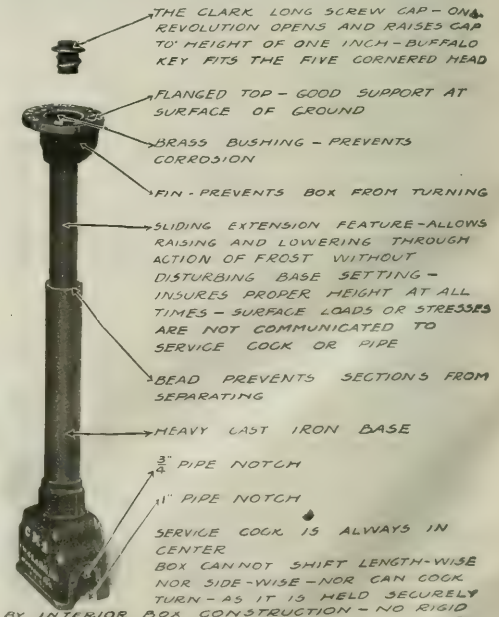
Its advantages are that it prevents the loss and breakage of bolts and tops, prevents digging up to adjust grade, prevents filling boxes with trash, prevents damage to service box or pipes caused by heavily loaded wagons and eliminates difficulty in engaging key.

TARVIA MACADAM ROADWAY

The Barrett Company has issued a booklet entitled "How a Tarvia Macadam Roadway Is Constructed" that contains useful and attractive road-building information. It illustrates and discusses the foundations, the stone quarry, the stone crusher, making the base course, rolling and filling it, placing and rolling the wearing course and covering it with hot Tarvia applied under pressure through a patent nozzle. It describes the placing and covering of the tarred surface, the application of the seal coat of Tarvia and the final coat of stone chips, finishing, rolling and maintenance and also gives information concerning the filling of joints in block pavements.



4 IN 1 COMBINATION TRUCK BODY DUMPED BY HYDRO HOIST


THE CLARK LONG SCREW CAP – ONE REVOLUTION OPENS AND RAISES CAP TO HEIGHT OF ONE INCH – BUFFALO KEY FITS THE FIVE CORNERED HEAD
FLANGED TOP – GOOD SUPPORT AT SURFACE OF GROUND
BRASS BUSHING – PREVENTS CORROSION
FIN – PREVENTS BOX FROM TURNING
SLIDING EXTENSION FEATURE – ALLOWS RAISING AND LOWERING THROUGH ACTION OF FROST WITHOUT DISTURBING BASE SETTING – INSURES PROPER HEIGHT AT ALL TIMES – SURFACE LOADS OR STRESSES ARE NOT COMMUNICATED TO SERVICE COCK OR PIPE
BEAD PREVENTS SECTIONS FROM SEPARATING
HEAVY CAST IRON BASE
¾" PIPE NOTCH
1" PIPE NOTCH
SERVICE COCK IS ALWAYS IN CENTER
BOX CANNOT SHIFT LENGTH-WISE NOR SIDE-WISE – NOR CAN COCK TURN – AS IT IS HELD SECURELY BY INTERIOR BOX CONSTRUCTION – NO RIGID CONNECTION REQUIRED BETWEEN BOX AND SERVICE COCK

SERVICE BOX FOR STREET MAIN VALVES

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Municipal Journal and Engineer Inc.

Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.

Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1927, under the Act of March 3, 1879

Vol. 50 APRIL 23, 1921 No. 17

Improvements in Trenton Water Purification

Rapid sand filters operated with abundant certain supply of home-made coagulant and disinfectant manufactured at an appreciable economy by the alum and chlorine plants recently installed.

The city of Trenton, N. J., derives its water supply, amounting to about 20,000,000 gallons per day for the present population of 120,000, from the Delaware river, which is polluted by sewage from up-stream and has variable and sometimes excessive turbidity due to coal dust held in suspension in time of flood which then makes its color almost black, and to clay eroded from the banks of the stream. Originally a considerable degree of the turbidity was eliminated by somewhat intermittant pumping and by sedimentation in the city reservoir.

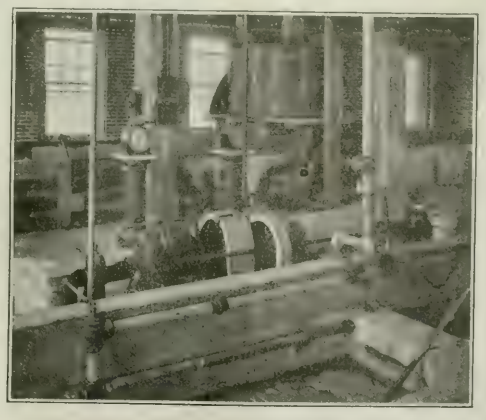
During the ten years ending 1900, the average death rate from typhoid fever in Trenton was 28 per 100,000 population, a mortality which increased in 1910 to 53 per 100,000. This high rate was considerably reduced by sterilizing the water with hypochlorite of lime used as a temporary expedient during the construction of a filtration plant (described in the "Municipal Journal" for October 22, 1914), where the water is purified by rapid sand filters which were designed by Johnson & Fuller and built in 1913 at a cost of about $450,000 under the supervision of F. W. Daggett, now superintendent of the plant.

GENERAL DESCRIPTION

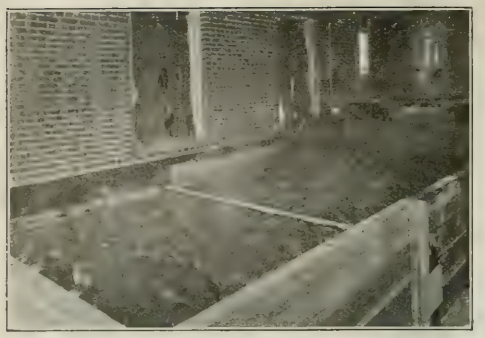
The plant, which has a capacity of 30,000,000 gallons of water per day, consists essentially of two covered sedimentation basins, 16 filters and a clear water basin, a head house, two 60-inch cast iron conduits and complete equipment. There are 2 centrifugal pumps, each of 20,000,000 gallons capacity, directly connected to 125 h. p. direct-current motors, which are automatically controlled by the water level in the sedimentation basin and pump against a maximum head of 25 feet. These pumps are located in the old high-lift station.

There are two 1,800,000-gallon, 210 x 62-foot sedimentation basins, each 18½ feet deep, providing for a 3-hour retention period when the filters are working at full capacity. There are 16 rectangular filter units, each with 652 square feet of sand area, and a capacity of 1,875,000 gallons per day when operating at a rate of 2 gallons per square foot per minute. Under the filters is a 1,200,000-gallon basin with capacity sufficient to supply the high lift pumps for about one hour.

A 40-foot telescopic steel tank, 49 feet in total height, operates like a gasometer to supply air and water under pressure for washing the filters and capacity sufficient for washing two filters at the same time. All of the filters and basins are of reinforced concrete construction and are carried on concrete columns. They are entirely covered by the brick head house and filter house.



APPARATUS BY WHICH CITY MAKES ITS OWN ALUM FOR USE AS COAGULANT



ALUM BOILING BY CHEMICAL REACTION IN THE CRYSTALLIZING TANK

PURIFICATION PROCESS

Raw river water is pumped over distribution and mixing weirs into the sedimentation basin, where the sediment is coagulated by sulphate of alumina applied through lead pipes. After the deposition of the greater part of the coagulated sediment, the water flows over weirs and through hydraulically operated sluice gates to the filter beds, from them passing through the strainer system and registering rate controllers into the clear-water basin, at the outlet of which the filtered water is dosed with chlorine, and is then pumped to the storage reservoir. The filters are of the negative head type and are washed at an average of about 40-hour intervals, requiring about 1.6 per cent of the total water filtered for washing purposes.

As the turbidity varies rapidly at times from a very small amount up to 3,000, and may change from 10 to 200 in 3 hours, the quantity of alum required for coagulating varies correspondingly from about 50 pounds to about 450 pounds per 1,000,000 gallons of water treated. About 2 pounds of chlorine is required for every million gallons of water treated.

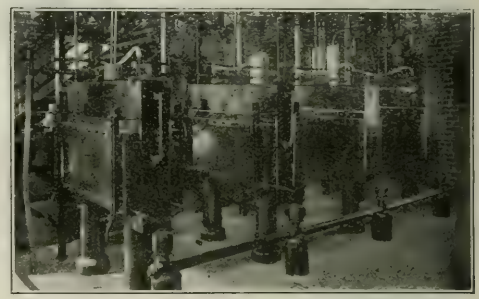
When the filter plant was put into operation, both alum and chlorine were purchased in the open market. During the war the price of alum and of chlorine was so much increased, the supply so much decreased, and the uncertainty of securing them was so great, that it became desirable to manufacture them at the plant, which has been done very successfully, insuring an abundant supply at a less cost than it could be purchased for.

ALUM MANUFACTURING PLANT

In 1918 a $15,000 plant was installed for the production of sulphate of aluminum by the Hoover process, which is essentially a simplification of the usual commercial process, modified so as to avoid the troublesome and expensive process of removing the insoluble silica, which is not considered particularly objectionable for filtration purposes.

Bauxite, the natural ore from which aluminum is made, and which contains about 55 per cent of the oxide of aluminum, is shipped from Arkansas at a cost of about $35 per ton delivered. This bauxite is mechanically mixed in steel tanks with about double its weight of sulphuric acid, and the resulting thick brown liquid is run into a 12 x 12-foot reinforced concrete tank, where very soon the chemical reaction produces furious boiling which lasts about 15 minutes, after which the mass solidifies and in about 24 hours becomes hard, tough and slightly porous and is chipped out in 5-inch lumps by pneumatic hammers.

This lump alum is hauled to the filter plant and placed in 7,000-gallon 12 x 12-foot reinforced concrete tanks, where it is dissolved with 19 times its weight of water in about 12 to 30 hours, according to temperature. During this process the solution is mechanically stirred to hasten the dissolving and to maintain in suspension the insoluble impurities, most of which consist of silica, which forms 12 to 15 per cent of the weight of the alum. The alum solution is used for dosing the water in the sedimentation tanks and requires special treatment in the way of flushing, etc., to prevent the clogging of the apparatus by deposition of silica. Last year 330 tons of alum were produced at an average cost of $28 per ton as compared with an average market price of about $45 per ton for commercial alum. The plant has a capacity of about 10 tons per week when operated by one man.



GENERAL VIEW OF FOUR ALLAN MOORE ELECTROLYTIC CELLS PRODUCING CHLORINE SOLUTION TO DISINFECT FILTERED WATER

CHLORINE PLANT

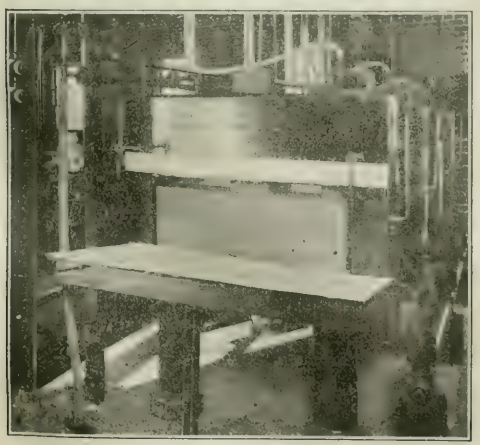
During the war the difficulty and uncertainty of securing chlorine was so great that it was necessary on various occasions to truck it from Philadelphia and other nearby cities, so that it was felt necessary to provide for a certain supply, independent of any possibility of increase or decrease in cost. It is very simply made by the electrical decomposition of brine, producing chlorine gas, caustic soda and hydrogen, the chlorine only being utilized at present, and the other by-products being wasted.

Common salt is placed in a cylindrical concrete tank 6 feet deep and a current of water is passed upward through it. The resulting brine is run over into a 400-gallon tank and soda ash is added to precipitate impurities. After a few days the liquid is pumped through a sand filter into another 400-gallon tank, where it is dosed with a small quantity of muriatic acid. The solution flows into a similar 400-gallon chlorine tank and then into three or four Allan Moore electrolytic

cells of 300 amperes capacity, which will produce 18 pounds of chlorine in 24 hours. The chlorine is pumped out of the cells by a water ejector, and is delivered to the clear-well. It is continually mixed with the filtered water in accurate amounts determined by the variable rate of consumption and by the results of bacterial analyses made from samples taken every 4 hours.

This method entirely eliminates the difficulties of handling chlorine gas, which involves considerable trouble and possible danger when it is purchased commercially in tanks under pressure, since the pressure may be greatly increased by high temperature and the tanks are likely to develop leaks that may be dangerous. The chlorine is manufactured in quantities that are proportioned to the amounts of water being pumped and are determined by the amperage on the cells and the amount of brine delivered to them, which are changed from time to time according to requirements.

The chlorine plant is of simple construction, all tanks being made of reinforced concrete. The total cost of installation was about $4,000 and as the operation requires no additional labor, the cost of production is practically that of the salt and electric current, which in 1920 was about 4½ cents per pound of chlorine produced, while the fixed charges, including interest, depreciation, and other items, amounted to about as much more, making the total cost 9 cents per pound and showing a decided economy over the purchase of chlorine in the market. This advantage was considered, however, to be only incidental because the essential feature was to provide a certainty of supply, and this is now reasonably assured by the facts that salt can always be secured, there is abundance of electric current, and little probability of failure of the electric cells, one of which is always in reserve; and that the process involves no complicated operations and requires no skilled labor and but little attention.



ELECTROLYTIC CHLORINE APPARATUS SHOWING INTERIOR OF 300 AMPERE CELL IN FOREGROUND

Unusual Engineering Construction Data

The construction of the 35 million dollar flood control work in the Miami valley involved problems requiring study and research work of an exhaustive character. The results of these studies were believed to be so valuable that they have been described in a number of unusual technical reports issued by the Miami Conservation District and for sale at the very low cost of from 50 cents to $1 each, excepting an atlas containing 139 drawings for which $1.50 is asked.

The titles of the different books are: Part 1—The Miami Valley and the 1913 Flood. Part 2—History of Miami Flood Control Project. Part 3—Hydraulic Jump and Back-water Curve. Part 4—Calculation of Flow in Open Channels. Part 5—Storm Rainfall of Eastern United States. Part 6—Contract Forms and Specifications. Part 7—Atlas of Selective Contracts and Explanation Drawings to Accompany Part 6. Part 8—Hydraulics of the Miami Flood Project. Part 9—Rainfall and Run-off in the Miami Valley. Part 7 is considered by the publishers to be the most valuable of the series. It presents the methods of determining the type of flood control plans and the methods of working out their applications. If these data had been available when the project was undertaken, it would have saved a great amount of expense and effort.

Gang Vs. Patrol Maintenance in New York

On this subject the state highway commissioner of New York, Fred Stuart Greene, says in his report for 1920:

We are glad to report that the extension of the gang system has proven of greater benefit to the state than our most optimistic expectations led us to hope. For the purpose of judging results, we point to the maintenance work done in one of the divisions of the department, where, during the season of 1920 no patrolmen were employed; all work being done by gangs. For patching, painting of guard rails and similar light work, small gangs of from two to four men were employed, while for the heavy reconstruction work gangs running as high as twenty men were used.

We quote below from a report submitted by the engineer in charge of this division:

"The gang system in this division has demonstrated that there is no comparison with the patrol system in any phase or feature of the work. . . ."

"The gang system which is more mobile always concentrates its efforts on the sections of highways which need repairs; this is not true of patrolmen for the reason that they were appointed to local beats. . . ."

"The real difference between the gang system and the patrol system is that the gang system completes its object and the patrol system never seems to reach it."

We believe that no better proof of the success of the gang system of maintenance can be given than to point to the condition of the highways during 1920. It is admitted that never in the history of road building was it more difficult to secure labor or material than during the past sea-

son, and yet it is stated by farmers, officials of automobile clubs, and by citizens who constantly use the roads that the state's system was never in better condition than during the past summer. We believe that equal results could not have been secured by the patrol system, and that our roads were in such good repair during 1920 was due to the greater efficiency of the gang system. At a meeting of the division engineers, held at the Albany headquarters during October, the gang system was unanimously endorsed and a majority of the engineers stated that in their opinions more work had been done with this system by June 15 of this year than was done all of last year by patrolmen.

Delaware State Road Contract No. 26

Contract 26 of the Delaware State Highway Department, in charge of Charles M. Upham, chief engineer, is for the construction of 5 miles of concrete highway, 18 feet wide, from Hard's Corner to Roger's Corner, south of Wilmington. It involves about 9,700 yards of concrete and 25,000 yards of grading and was awarded to Fisher & Crozza, Baltimore.

Sand, broken stone and cement are received by rail and the cement is stored in two 20 x 40-foot houses parallel to the railroad track and about 15 feet apart, that are united by a loading platform 7 feet high above the surface of the ground, on which the cement, wheeled from both houses, is conveniently dumped into the batch boxes.

Sand and gravel are delivered in carload lots on the siding adjacent to the main track of the railroad and are unloaded by a locomotive crane traveling on a service track between the cement houses and the siding. They are stored in large piles on the surface of the ground, one adjacent to each of the cement storehouses.

The locomotive crane reclaims the stone and sand from the piles and deposits them in 50-yard bins built on the cement shed roof, which slopes in one direction only and is 14 feet high on the lowest side. On the side opposite the locomotive crane the bins are provided with gates and chutes through which the aggregate is delivered to batch boxes loaded in sets of four on motor trucks that haul them to the Koehring mixing machine that follows the Koehring grading machine.

After the concrete has been placed on subgrade between Blaw-Knox steel forms it is finished with a Lakewood finishing machine, covered with earth or sand, and kept wet for 14 days, according to the standard specifications.

Water for the job is pumped by the contractor through a 2-inch line extending the full length of the work and operated by an automatic electrically driven pump.

With an average force of about 20 men, the progress of the work during last summer was about 275 linear feet per 9-hour day and it is expected that the work, which was begun in July and was two-thirds completed last fall, will be finished early this season.

The method of using trucks instead of an industrial railway for transporting the batch boxes to the mixer is made possible by the wide shoulders and excellent shoulder material. The results of this system have been very satisfactory and the overhead charges for plant are considerably less than with the industrial railway system.

Forms of Construction Contracts

Discussion at the New Orleans convention of the Associated General Contractors.

Among the principal points made by the members discussing cost-plus, lump-sum, fixed-fee and other types of contracts at the convention of the Associated General Contractors, the most important were the necessity of different types for different occasions; inclusion of overhead in cost; uniformity; freedom of employment; and injustice of putting undue responsibility on the contractor.

J. Waldo Smith, chief engineer, Board of Water Supply, New York City, saids: "I am against cost-plus contracts in general. I think they can only lead to the grossest favoritism and unfairness, and that they will tend to stifle resourcefulness and inventive ability of contractors, and in the end they would spoil the contracting business.

"I am perfectly willing to admit, however, there is a place for all kinds of cost-plus contracts, as well as lump-sum contracts, because we have conditions arise where work must be done under stress of great emergency, and in such cases such contracts are the only way that work can be done. There are other cases where the plans are incomplete, where it would not be possible for contractors to make intelligent bids, and there are other cases where the elements of doubt and uncertainty are too great a proportion in the whole job to allow of an ordinary form of contract.

"But in general it appears to me that the old form of contract, either the itemized or the lump-sum with full information, is the one that will secure the greatest good for the greatest number.

"I know, just as well as you do, that there has been a tendency for the lawyers, aided by the engineers, to seek to establish forms of contracts in which every form of responsibility is on the contractor. I would not excuse the engineers for their assistance to the lawyers; it's all wrong and can lead to no good, and I am sure it is a practice which you as contractors deprecate fully as much as I do."

A. J. McKenzie, McKenzie Construction Co., San Antonio, said: "It is essential that we have some contract that protects the contractor for the younger architects and engineers to copy. If we can get some organization like this or the American Institute of Architects to prepare a uniform contract that all these young architects and engi-

neers will copy, we are much safer. In San Antonio, for instance, all the architects practically have adopted the standard contract of the American Institute of Architects, but in the engineering work this is not the case and our engineering contracts are very much one-sided.

"It is for this reason that the Texas section of the American Society is attempting to prepare a uniform contract that can be copied as a general rule to apply to most construction work.

"With reference to the forms of contracts, I know of no way of letting public work except by the lump-sum or unit-price methods, it is necessary that we prepare a contract whereby the contractors will be protected against the unscrupulous engineer or architect.

Mr. O'Leary, of New Orleans, said: "I am in favor of a fixed-fee contract. It is possible to get all the benefit if you can make an estimate of your cost and if you will let your fixed fee share in any excess that goes over that to a certain amount. You can get a man struggling just as hard to have that contract come out for the amount you figured it, as if you had a lump-sum contract. It's all right with the fellow that gets the higher result. What we've been up against more than anything else in the lump-sum contract has been the fellow that bids too low—sometimes because he didn't care and sometimes because he had made a mistake. We took these contracts because we needed them to keep our organization together, and we lost.

"If you will let the owner have the benefit of any saving and do him an honest job, then all the time you are aiding the better class of contractors. The results do come out right and if they don't, you share in his loss. I think that is a good form of fixed-fee contract and is a better protection for you than the lump sum and is fair to the owners, too."

Allen J. Krebs, of Atlanta, Ga., said: "After my experience with government work of about eighteen months, I spent many moments in my executive capacity wondering why we didn't get better results, and if it was a question of the integrity of our associates in the general contracting business who were not putting behind it sufficient service, and finally I realized that there was an insidious influence that operated against us and against the owners under the cost-plus system.

"We were exploited by the laboring people and we were exploited by the material people and we had no other recourse, if we wanted to fulfill our obligations, than to accept the circumstances and proceed with the work.

"I believe when the committee prepares these uniform contracts it should furnish us with a contract that will suit cost-plus work and a contract that will suit lump-sum work.

"It is our prerogative as contractors to work on any basis which we think is the proper policy for our firm. Fundamentally any firm that is equipped with brains, experience and that one essential of integrity and honor, can fulfill any contract whether it be of cost-plus system or lump-sum contract, and therefore, as it is our prerogative to work on either basis, I think that this committee should furnish us with a contract guaranteeing to us justice under both systems.

"The same thing applies to your question of labor. It is our prerogative whether we should work a union shop or a closed shop, and on those principles I insist that that be our prerogative as a national association, and when those things are considered in that light where we can operate as men with efficiency and honest purposes, we can continue. As for myself, I am opposed to cost-plus work."

Road Drainage Structures in Giles County

By T. C. McEwen*

This county is thinly settled, and only $3,000 to $4,000 a mile was available for road improvement, but labor is cheap. Therefore, for bridges, local materials—locust and chestnut poles and field stones—were used.

Giles county, on the Alabama border of Tennessee, is hilly, with numerous creeks, branches and steep hillsides, which necessitate more than the usual number of drainage structures. With only $350,000 voted for roads and bridges, giving from $3,000 to $4,000 a mile, and the high price of labor, material and machinery, the writer was handicapped in carrying out any satisfactory construction.

After discussion with the County Highway Commission, it was decided that local labor be employed, since this plan was believed to have many advantages over the contract system on roads of this character. The men living in the community where the road is being built are given employment; they can better discuss road locations, secure rights of way, and select a man of the neighborhood best fitted to act as foreman; and they are directly interested in the road, for they are to use it, and will therefore give more fully of their time and energy in building it.

It was the purpose to use inexpensive machinery and such as could be continued in use in maintaining the roads after completion; also, because of the inexperience of the labor, the simplest of machinery and implements. Six or eight grading machines, a number of slips, hand drills, hammers, shovels and bars were the only tools purchased.

By this method of road building, all of the bond issue money except a small portion for equipment is paid back to the men in the community. This system was inaugurated in August, 1920, when labor was at its highest, receiving 25 cents per hour, and 60 cents was being paid for teams. Since then, however, there has been a reduction to 20 cents for labor and 45 cents for teams. Twenty crews were started to work the first of August, 1920, and up until the present time approximately sixty miles of road has been

*County Engineer; 1st Lt. E. R. C., U. S. A.

graded, graveled and drained. The work has not been carried on continuously, as provisions were made whereby the farmers were allowed to get off when it was necessary to tend crops.

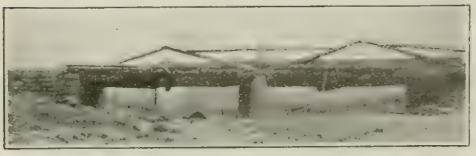
This is an entirely new method of expending bond issues for road construction in Tennessee, and an entirely new one to the writer. Its success has been due entirely to the honor and integrity of the men who were selected to carry on the work. To have contracted these roads it would have been necessary to delay the letting of this work for at least one year while surveys, plans and specifications were being worked out in detail, and the funds available would not have built the type of roads that are now being built. The cost of grading and graveling would be more than doubled. The cost of graveling alone by contract averaged $1 per cubic yard placed and spread on the road. We are now putting this gravel down at an average cost of 75 cents per cubic yard.

DRAINAGE STRUCTURES

The chief purpose of this article is to describe in detail the cheapness of the drainage structures that were used. In order, however, to appreciate why such structures were built, it was necessary to outline the amount of money available, the class of workmen, the materials and tools at hand.

After investigation, it was found that black locust poles and chestnut poles could be obtained very cheap. Also, that locust fence posts were in an excellent state of preservation after being in use for fifty-two years, while a chestnut pole bridge, constructed twenty-eight years ago, and still in use, was examined and the timber was found to be sound and serviceable. It was therefore decided to use chestnut and locust poles for culverts and short-span bridges.

A typical structure of this kind is one across Indian creek. This was made in two 25-foot spans, each consisting of two king trusses, each truss supporting one end of a midway transverse



INDIAN CREEK BRIDGE

floor beam 10-inch diameter and 23 feet long. The bolt supporting the beam is 1¼-inch circular. The trusses were set 14 feet apart in the clear, and were braced by batter posts from the top of the truss to near the end of the floor beam, which extended about 3½ feet beyond each truss. The bottom chord of each truss was a locust pole about 10-inch diameter. The chords of the two spans were lap-spliced and spiked together, forming a continuous stringer.

Resting on one abutment and the pier and on the floor beam at the middle were five locust stringers about 10-inch diameter and 28 feet long. On these stringers 5-inch locust poles were laid close together transversely and spiked to the stringers. On top of these a 10-inch pole was laid against and spiked to the truss on each side to act as a curb, extending the full length of the bridge and retaining the gravel roadway in place. The crevices between the 5-inch poles were filled with broken stone, covered with two inches of clay which acted as a seal to hold the water. On this was placed about 8 inches of creek gravel for the roadway surface.

The material used comprised sixteen 28-foot locust poles costing $58 delivered; 120 5-inch locust poles costing $36; ten 20-foot poles, $20. The end abutments were of dry rubble about 2 feet thick at the top, 2½ at the base, 8 feet high and 16 feet wide, costing $140 by contract with a local farmer. The labor of building the abutments from stone found at the site, and of framing, etc., was $86, four men doing all the work. The total was $340.

At another point a 3 by 3-foot box culvert was built of stones from the site, covered with twenty-five 5-foot locust poles carrying a 20-foot roadway, at a cost of $22.50. A 10-foot culvert was built with dry rubble abutments 6½ feet high, bridged by 12-inch by 18-foot stringers. The two outside poles on each side were drift-bolted together and a curb pole was drift-bolted on top of the outer one, with a space of 20 feet between them for the gravel, which, with broken stone and clay, was placed as described for the bridge. The stone for this culvert was hauled 3½ miles. Five men consumed five days in quarrying the stone and five more in building the culvert. The cost was $150.

CONCLUSION

The life of these structures, I am sure, will exceed twenty years, and figuring the interest on the principle invested in a permanent structure,

GOOD SPRINGS CULVERT—TEN FEET SPAN

you can readily see that you have saved sufficient money to perpetually replace these structures.

The assessed value of this country was $9,000,000 when the bonds were voted, there was a population of something over 30,000, and the area of the county was approximately 600 square miles; so you will readily see that in order for the inhabitants to get the benefit of any road, it would be necessary to distribute this fund over a wide area.

It is hoped that this information will be of some benefit to engineers and road builders who are situated as the writer, and whose funds are so limited that only the cheapest type of a gravel road could be considered.

PUBLIC WORKS

Published Weekly
by
Municipal Journal and Engineer, Inc.
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba....$3.00 per year
All other countries ....$4.00 per year

Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office, Monadnock Block, Chicago

A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

CONTENTS

IMPROVEMENTS IN TRENTON WATER PURIFICATION—Illustrated 341
Unusual Engineering Construction Data 343
Gang vs. Patrol Maintenance in New York 343
Delaware State Road Contract No. 26 344
FORMS OF CONSTRUCTION CONTRACTS..... 344
ROAD DRAINAGE STRUCTURES IN GILES COUNTY—Illustrated—By T. C. McEwen..... 345
EDITORIAL NOTES 347
Road Maintenance Urged by the President—A Choice of Contract Forms—Mosquito Extermination Along Highways
Non-Rigid Bases for Pavements 348
Dr. Waddell Honored by the Chinese Government... 348
Sewage Treatment at Lexington 348
STATE HIGHWAY SPECIFICATIONS..... 348
$51,000,000 Provided for Baltimore Municipal Construction 350
SHORT-SPAN HIGHWAY BRIDGES—Illustrated. 350
LIABILITY OF MUNICIPALITY FOR NUISANCE IN GARBAGE DISPOSAL—By John Simpson 354
PRESENT STATUS OF ACTIVATED SLUDGE PROCESS 356
SUBSTITUTES FOR SEWERS—Illustrated—By W. A. Hardenbergh 358
Non-rigid Base for Granite Blocks 359
Modern Road Building and Maintenance 359
WHAT ARE THE ADVANTAGES, DISADVANTAGES AND USES OF LIMESTONE IN HIGHWAY CONSTRUCTION? 360
A WORKABLE FORM OF CONTRACT—By John Lyle Harrington 361
ENGINEERS AND CONTRACTORS 362
Masonry Structures 362
RECENT LEGAL DECISIONS 363

Road Maintenance Urged by the President

"I know of nothing more shocking than the millions of public funds wasted in improving highways, wasted because there is no policy of maintenance." This quotation from the address of President Harding to Congress on April 12 gives prominent emphasis to a fact which this publication has been asserting in various ways for several years past. Our special highway number of April 16, 1916, was devoted almost exclusively to the subject of highway maintenance. In the editorial in that issue, we stated that "If this amount (the cost of maintaining the highways) is not spent, the maintenance problem soon solves itself—there will be no roads left to maintain." In support of this statement, we cited the instance of one eastern state where, against the advice of the highway department, the legislature made no appropriation for maintenance, but doubled the recommended appropriation for construction, with the result that within two or three years a considerable percentage of the roads already built had to be entirely reconstructed, there being nothing left of them to repair.

As we have said time and again, we consider maintenance even more important than construction; although, of course, where the total annual cost, including both interest and maintenance, can be reduced by reconstruction, this is the proper thing to do. There will be no disputing by engineers of the claim of the President that it is inexcusable waste to spend millions on constructing highways without at the same time or previously making provision for maintaining in good condition not only the highways to be constructed, but those which are already in service.

Present indications are that, if an additional appropriation is made by Congress for federal aid, it will be conditioned on a proper provision by the states for maintaining highways for which aid is granted; and if Congress fails to make an appropriation, this will largely be due to the fact that the states have been so wasteful of the funds already received and so criminally remiss in failing to provide for the maintenance of the roads constructed by aid of the federal funds now practically exhausted.

A Choice of Contract Forms

The discussion in this issue of different forms of engineering construction contracts may be taken as a fair presentation of the views generally held by the men most interested and best qualified to judge of the types of contract suited for important construction work. That their opinions are disinterested is proved by the fact that there are no advocates for the exclusive use of the cost-plus-percentage system that, although admittedly necessary in some occasions, obviously offers advantages for excessive and unfair profit.

The very rational opinion prevails that there should be a choice of two or more types of contracts suited to widely varying conditions and requirements and that there should be as large a degree of uniformity as possible in contract requirements.

Given these conditions, with experienced contractors of a high type fully equipped with plant and resources, and a fair competition with proper supervision, and there is little doubt that construction work will be faithfully and advantageously executed and that each contractor will have every opportunity for reaping considerable reward for his investment, experience and special skill, ingenuity and courage.

Mosquito Extermination Along Highways

The importance of endeavoring to eliminate mosquitos from the vicinity of highways has been pointed out by the United States Public Health Service in a recent bulletin. This bulletin refers to the suggestion of Dr. T. F. Abercrombie, health officer of Georgia, that gangs working on

roads be required to fill up borrow pits, to properly place and construct culverts, clean ditches and attend to such other small, but important, details as will deprive the mosquito of many of her breeding places.

The especial importance of this along highways is due to the fact that, while to transmit malaria ordinarily, an anopheles must first bite someone afflicted with malaria and later find another victim to whom to communicate the malaria germ, a mosquito dwelling along a roadside has an excellent chance to acquire malaria germs from a passing traveler and to find numerous victims for receiving the same coming to her along the road. Thus the opportunity for spreading the disease is very much greater along the roadside than where the mosquito itself must do the traveling. A single malaria patient driving along the ditch-bordered, mosquito-infested road may provide hundreds of the insects with germs which they may pass on to every traveler along that road

Non-Rigid Bases for Pavements

Under the above title we published an article in the February 5 issue and for illustrating this used several photographs of California pavements. One of these, on page 112, was entitled "Asphaltic Concrete Base in Alameda," the sub-title stating that this was a two-inch asphaltic surface on a three-inch asphaltic concrete base. After the appearance of this article we were informed by someone familiar with the city that the pavement photographed was not of the kind stated, but that if the camera had been pointed in the opposite direction along the same street the description would have applied. We have taken the trouble to verify this statement and find that it is correct, the photographer or someone else having made the mistake. As a matter of fact, the pavement shown is oiled macadam.

Dr. Waddell Honored by the Chinese Government

With reference to the new bridge that the Peking-Hankow Railways have decided to build across the Yellow river, for which bids have been invited in this country and elsewhere, information has been received by the Chinese Legation at Washington that the Chinese government has decided to appoint a commission of four advisers for examining the designs submitted.

One bridge expert is to be chosen from each of four nationalities, namely: American, Belgian, British and French. Dr. J. A. L. Waddell, the well-known American bridge expert of New York, has been selected by the Chinese government to be the American member of this commission. Dr. Waddell has accepted the appointment and will soon proceed to Peking, probably being absent from the United States six or seven months.

Dr. Waddell will be consulted by the Chinese government principally with reference to the new Yellow River bridge. The Chinese government is very much pleased to be able to obtain the valuable services of so well-known a consulting engineer as Dr. Waddell. During his sojourn in China many important matters in connection with railways will be referred to him in order to get the benefit of his expert advice.

Sewage Treatment at Lexington

Our attention has been called to the fact that, in describing the sewage treatment plant at Lexington, Ky., in our issue of March 26, we neglected to give the names of the engineers responsible for the design of the plant. The Solomon-Norcross Company at Atlanta were the engineers for the plant, the design having been made by Mr. Norcross, who is now a member of the firm of Norcross & Keis, of Atlanta.

State Highway Specifications

Most of the state highway departments have made few, if any, changes in their specifications, but there are a few exceptions. Indiana believes its concrete mix was too rich. Iowa has made some important changes in its concrete specification, which are described in full in this article.

During the past few weeks, in endeavoring to secure highway information on certain points from state highway departments, we asked whether any changes were being made in the specifications for the year 1921, and in almost every case we were informed that no changes were being made or that only minor ones were contemplated. That no changes will be made is reported by Rhode Island, Connecticut, New York, Illinois, Alabama, North Dakota and Ohio; Nebraska was revising its specifications last month; Idaho has made only minor changes, mostly in nomenclature; North Carolina has not yet made any definite changes; Missouri will make few if any changes, in Montana changes have not yet been definitely decided upon, in New Hampshire changes are of only a minor nature. Several of the states did not answer this question and it is assumed that no changes are being made.

In Delaware no very radical changes are being made. Due to the uncertainty of the material market the state will not furnish contractors with road building material as it did last year. Some slight changes are being made in the specifications relative to the details of finishing and curing concrete pavements, but these had not been finally decided upon.

In Indiana the most important change is one of the composition of the concrete in pavements. Under the 1919 Specifications, the mix was a 1:1½:3 with a minimum of 1.91 barrels of cement to the cubic yard of concrete in place. Under the 1920 Specifications, the mix is a 1:2:3 with a minimum of 1.70 barrels to the cubic yard of concrete in place. The 1:1½:3 mix was found to be too rich. Also all concrete pavement is to be

machine finished, and forms shall be according to the following:

Forms. The outside forms for the concrete shall be of steel, having a top flange not less than two and one-quarter (2¼) inches wide. They shall be straight and rigid, of a height equal to the thickness of the pavement at the edge and shall conform to the following requirements:

Machine	Weight of Finishing Bottom Bearing Area per Lineal Foot	Weight per Lineal Foot
3,000 lbs. or under	39 Sq. Inches	6.5 lbs.
3,000 to 4,000 lbs.	48 Sq. Inches	8.0 lbs.
4,000 lbs. and over	54 Sq. Inches	9.0 lbs.

The forms shall be staked at intervals of not more than five feet and by such means as will maintain the required alignment and grade with exactness. The stakes must be so driven as not to interfere with finishing operations. The contractor shall provide sufficient forms so that it will not be necessary to remove them within twelve hours after the concrete is placed. Before concrete is deposited against the forms, they shall be cleaned thoroughly and oiled.

Pennsylvania has issued seven typewritten pages giving the principal changes in the specifications, most of them for explaining or more clearly expressing statements of the 1920 specifications rather than changing the ideas. These changes have to do with general provisions such as the contractor's responsibility for the work, annulment of contract, progress payments, handling materials, and measuring devices; also expansion joint fillers and transverse expansion joints in concrete pavements, and description of the reinforcing materials to be used in such pavements; in connection with sheet asphalt pavements, the penetration of the asphalt cement has been changed, as has also the temperature of the completed mixture, and certain changes have been made in the details of construction. Various changes in details have been made in connection with asphaltic concrete, warrenite and amiesite pavements. Other changes have to do with pipe culverts and wooden railings, most of these being unimportant modifications or explanations.

IOWA SPECIFICATIONS

The Iowa state department has changed its specifications in several minor respects and one rather important one, in that its "type B" pavement, instead of consisting of "two courses of concrete, a base course and a wearing course," this year consists of "a single course of concrete of the full depth of the pavement with a wearing course of abrasion resisting stone forced into the surface of the concrete and made a part thereof." In connection with this change, it is required that the coarse aggregate for the wearing course of "type B" pavement "shall consist of clean, sound crushed trap rock, quartzite, granite, or gravel pebbles. This aggregate shall contain not more than 15 per cent of limestone, sandstone or other similar soft material. Such limestone, sandstone or similar soft material shall have a French co-efficient of wear of not less than 8. The soft or partially disintegrated particles shall not exceed 2½ per cent. It shall contain no slate, shale, coal or other materials which easily disintegrate, and shall be free from frozen lumps, sticks, flat and elongated pebbles, and vegetable or other deleterious material. It shall pass, when dry, a screen having 2½-inch openings and not more than 10 per cent shall pass an opening of one inch."

Also, instead of finishing "type B" pavement in the same way as "type A": "In the case of type B concrete pavement, after the concrete has been deposited, the surface shall be struck off in the manner described above for 'type A' hand-tamped pavements, and made true to grade and cross section. The course of abrasion-resisting stone shall then immediately be cast upon the surface of the concrete in an amount sufficient to completely cover same. This stone shall be forced into the surface of the concrete and made a part thereof and the whole mass thoroughly compacted by means of any mechanical device or appliance which will force out the excess water and will leave the course of abrasion-resisting stone embedded in mortar and parallel to the finished surface of the pavement. Any excess mortar shall be uniformly spread over the entire surface. Before the concrete obtains its initial set, the surface shall be belted. This belting shall be of short, rapid transverse strokes having a sweeping longitudinal motion. The belt shall be worked back and forth across the pavement until a uniform surface of gritty texture is secured. The belt must not be over three-ply and not more than 5 inches wide. Badly worn belts must be discarded and new ones supplied."

There is also the additional requirement this year that "In both 'type A' and 'type B' pavement, whether hand or machine finished, after the final belting an edging tool shall be used along the side forms, and the edges of the pavement completed in a finished and workmanlike manner."

The other changes in the concrete specifications are as follows: For coarse aggregate it is permissible to use either crushed trap, quartzite or granite, or screened and washed gravel, or crushed limestone. Last year each of these was required to have a French co-efficient of wear of not less than 8, but this year the gravel is specified to have a co-efficient of not less than 7; and the same is required for the limestone also and it is additionally specified that it "shall not contain more than 5 per cent of material having a French co-efficient as low as 5," while last year the specifications called for not more than 15 per cent with a co-efficient as low as 6.

Last year shale was prohibited in the aggregate, but this year it is specified that "the coarse aggregate may contain not more than 0.5 per cent of shale pebbles if, in the opinion of the engineer, such pebbles are not of an especially injurious nature." Also the amount of coarse aggregate retained on screens with 0.185-inch openings is 95 this year as against 96 last. Provision is made for using unscreened gravel, but all the particles must be clean and sound and those passing a screen with 0.185-inch openings shall conform to the requirements for fine aggregate and that portion retained on such screen shall conform to the requirements for coarse aggregate.

In selecting coarse aggregate for "type B" concrete pavement this must meet the requirements for coarse aggregate for "type A" pavement, except that, if it does not meet the requirements as to French co-efficient of wear, it may be accepted if concrete made from a representative sample in

the proportion 1:2:4 develops an average crushing strength at the end of 28 days of 2,500 pounds per square inch.

A new provision is that for the proportioning of cement to unscreened gravel used for either type of pavement, a table being given showing the ratio of cement to aggregate by weight, this varying with the percentage of fine aggregate in the unscreened gravel. When this is 33 per cent, the ratio of cement to unscreened gravel is to be 1:5.18. When between this and 40 per cent, the ratio is 1:4.84, and ratios are given for each successive interval of 5 per cent up to a ratio of 1:1.87 when the aggregate is more than 95 per cent sand. This gives from 1.6 barrels of cement per cubic yard in the first case to 3.13 barrels in the last. Last year the specifications prohibited crusher run of stone or bank run gravel "unless specifically authorized in the special provisions."

A few changes are made in the construction specifications. Last year it was specified that if the amount of cement used in any three adjacent blocks is less by more than 4 per cent, or if the amount in any one block is less by more than 7½ per cent of the amount required, the contractor must remove the blocks and reconstruct them. This year, if such condition is found, "the engineer shall at once check up the proportioning and satisfy himself that the ratio of cement to fine and coarse aggregate is in strict accordance with these specifications."

The slump test for consistency last year required that a truncated cone with a 4-inch top diameter and 8-inch bottom and 12 inches high should not slump more than 2 inches when a mechanical finishing machine is used nor 4 inches when the finishing is done by some other approved method; while this year the slump is limited to one inch and 2 inches, respectively. Last year it was required that if hand tamping be used, "at least 4 men shall be engaged at the exclusive work of tamping the concrete," while this year it is provided that the tamping "shall meet with the approval of the engineer." An additional requirement this year is that "the placing of loads or piles of fine or coarse aggregates directly upon the sub-grade or upon the shoulders immediately adjacent thereto to be wheeled, shoveled or conveyed directly to the mixer, will not be permitted. Driving or hauling upon piles or fine or coarse aggregate will not be permitted."

$51,000,000 Provided for Baltimore Municipal Construction

There is now available for engineering construction, extensions and improvements in the city of Baltimore $51,000,000 which will probably be expended within the next three years.

Among the principal improvements contemplated is raising 50 feet the present concrete dam of the Gunpowder river water supply. This work will be a simple concreting job involving few special features except the waterproofing of the joints with the offsets in the old structure, and the construction of a seepage gallery to supplement the one already installed. It is expected that the work will cost in the neighborhood of $500,000.

About $4,500,000 more is required for completing other water supply improvements and developments.

The area within the city limits has been extended from about 33 square miles in 1918 to 90 square miles at the present date. This extension has involved the acquisition of one large independent water supply and several small ones, some of which may be abandoned and the others incorporated in the distribution system.

The question of metering the water supply to consumers should be presented in an active campaign that, if successful, will postpone the construction of an extensive and costly filtration plant that will otherwise have to be commenced within a year. It is estimated that about 160,000 meters should be installed at a total cost of about $2,500,000.

About $8,000,000 is required for extension of brick and concrete storm sewers and vitrified house sewers. About $7,000,000 is required for new school houses, $2,000,000 for the extension of conduits, $10,000,000 for harbor development and construction, $11,000,000 for paving, chiefly asphalt, and $1,250,000 for possible filtration plant.

Short-Span Highway Bridges*

Materials in common use. Designing and constructing steel bridges, concrete arches and concrete girders. Maintaining bridges.

MATERIALS

Superstructures may be built of wood, stone, brick, concrete, reinforced concrete, cast iron or steel, or of a combination of these materials. The former extensive use in this country of wrought iron or cast iron for arches, or of combinations of cast iron and wrought iron, and wrought iron and wood, are almost entirely superseded by steel or concrete or reinforced concrete. Wood was also formerly used for arches and girders, but on account of its rapidly increasing cost and scarcity, and because of its limited strength and durability, its use is rapidly diminishing and is now almost entirely confined to temporary structures and short girder spans generally supported on pile trestles, except in very inaccessible regions where timber is still abundant and freight on iron and steel are excessive.

Wood is still used extensively for floor planks, especially on movable spans, and for fixed spans in rural districts. Cast iron is now rarely used, except in a supplemental way, as for bearings, railings and ornamental purposes. The largest amount of highway bridge work in this country is built with steel or reinforced concrete or with a combination of these. Steel is lighter, can be

* *Continued from page 316.*

more exactly proportioned, is less liable to be of poor quality and workmanship and can be most quickly erected. Concrete, on the other hand, usually possesses a larger factor of strength and durability, requires less maintenance and is more readily adapted to artistic and architectural effects.

STEEL SPANS

All movable spans are of steel, and steel may be used for arches, truss spans and girder spans as well as for the piers or columns which support them. Movable spans are sometimes displaced horizontally in a direction parallel or diagonal to their axis, in which case they are called retractile spans. These, however, are infrequent, and movable spans are generally made to revolve in a horizontal plane, when they are called draw spans; or in vertical plane, when they are called bascules. Or they may be built to rise and fall vertically, and are then called lift bridges. In any case, movable spans require very reliable, immovable supports and considerable costly operating mechanism.

Formerly swing bridges were most used, but now the bascule type is in general favor. Any kind of floor may be used with the swing and lift bridges, but a special provision must be made for bascule bridges to retain the floor when the bridge is in a vertical or inclined position, therefore brick and block pavements are seldom used on them and plank floors are frequently adopted, although steel or reinforced concrete may be used. When movable spans are used they are, if possible, located symmetrically or in the center of the structure and generally have monumental piers or architecturally treated features at the ends or centers of the spans.

Steel spans may be of deck or through types and may have trussed arches, spandrel braced arches, or they may have either simple or cantilever trusses or girders. Girders are most suitable and economical for short spans, while arch trusses are apt to be the most attractive and present the most artistic appearance for longer spans. The arch spans may be without hinges, with two hinges or with three hinges, and are most advantageously adopted when they can be supported directly from solid rock foundations at both ends.

Simple trussed spans have usually horizontal bottom chords and may have either horizontal or inclined top chords. The different members may have field or shop riveted joints or be pin connected, the former system being now considered more desirable. Other things being equal, the deck type is more simple and economical, but of course, requires sufficient head room below, and often cannot be used because of the limiting elevation of the roadway.

Plate girder bridges may either have riveted girders or be made with single heavy rolled type girders. They are simpler and more rigid but weigh more than the trussed girders. Plate girders are usually used for short spans, although they are practicable for length up to 100 feet, and where the depth is limited for deck spans, as where an extreme minimum of underneath clearance is available for deck girder spans, they are sometimes made of the cantilever type, with a shallow center span suspended from the two arms, thus requiring the least possible depth of longitudinal girder at the center of the span. The principal advantages of girder spans are their simplicity, durability, and the fact that they can be entirely fabricated at the shop, shipped to the site, and erected as units for small spans and as complete girders for the larger spans, thus involving a minimum of time and labor in the field.

The larger spans are generally used for crossing over depressed railroad tracks. It is difficult to apply artistic or architectural treatment to relieve severity and angularity of their outline. They are often enclosed completely in concrete, especially when it is necessary to protect them from gases and corrosion, and sometimes to facilitate their architectural treatment. All kinds of steel bridge spans can be constructed without difficulty to give absolute security for any given condition of loading, but they generally possess very little excess strength above the specified requirements.

Constructing Steel Girder Spans. Steel girders are generally shipped in sections or as separate members and are assembled at the site on wooden falsework, or are placed immediately on the per-

BRIDGE AT MASSENA, N. Y.

Four 81-foot spans with 30-foot roadway and two 7-foot sidewalks. Built in 1918 at a cost of $68,000. Concrete Steel Engineering Co.

BRIDGE AT GREENWICH, N. Y.
120-foot Melan arch concrete span built in 1916, cost $15,000.

manent sub-structure. The steel is handled in the field by derricks, locomotive cranes, gantry cranes or travelers, such as are used by railroad bridge erectors. These spans can often, if necessary, be erected complete, ready for use, adjacent to the old structure where the latter is still in service, and then the old and the new spans can be simultaneously moved until the new one takes the place of the old one and immediately receives the traffic, while the old one is dismantled at leisure. Under favorable circumstances a steel span of 100 feet can be erected within 4 or 5 days after the steel is all received at the site.

Complete spans or girders may be delivered on flat cars on existing tracks, unloaded and lowered to position by jacking without requiring any special apparatus. When the sub-structure is ready, existing spans of 50 or 75 feet may be displaced and a new one put in place and ready for service in a minimum time of 3 hours after all preparations have been made. They thus involve a very short interruption to traffic.

CONCRETE ARCHES

The use of concrete and reinforced concrete arches for highway spans has increased enormously within the last few years and they will probably eventually supplant other types in a very large percentage of all spans between 30 and 160 feet in length. Within generous limits they may have any required dimensions and lend themselves very readily to a wide range of architectural and artistic treatment and embellishment at a moderate increase over the minimum cost. The concrete may be made monumental in character and consistent with high class surroundings so as to have features in keeping with the suburbs and landscapes.

They almost invariably possess a large excess of strength without materially increasing the minimum cost of construction. They are very durable and require little or no maintenance. They are not, however, articles of manufacture, cannot be fabricated in factories, purchased complete, or shipped from place to place, but should always be designed specially for each given site by competent engineers and built by experienced contractors. They require larger piers and more secure foundations than are indispensable for steel bridges, and cannot be as quickly erected and opened for travel. They cannot be shifted from place to place, and cannot readily be reconstructed. They require considerable height between water level and the top of the floor and are not adapted for supporting a through roadway.

Construction. The construction of the substructure generally requires derricks or their equivalent, and a complete concrete storage, mixing and distributing plant. For work below the water level, sheet piling, cribs, cofferdams and pumping equipment are often required. Operations are generally simple and can be executed by any organization and equipment for ordinary engineering construction and foundation work.

BRIDGE AT CLARKS MILLS, N. Y.
Three Melan rib 86-foot arch spans, 20-foot roadway, no sidewalks. Built in 1916 cost $17,000, Concrete Steel Engineering Co.

The same plant that is installed for the substructure is usually suitable for a large part of the construction of the superstructure of concrete or reinforced concrete arch spans. As for the sub-structure, the concrete may be distributed by service tracks on the new structure, or on an adjacent old one, or on falsework trestles alongside, by derricks or by cables. The arch forms require support on strong and rigid centers and these may either be made with pile and trestle falsework or with movable trussed centers, generally built of steel for spans in excess of 40 feet.

The arch rings are usually built in successive sections corresponding to the voussoirs of masonry arches, and the form work is comparable with the work of any other heavy concrete construction. There is abundant field for ingenuities and economies in design and handling the concrete plants. Competent specialists are available for designing structures and the construction plants and the equipment can be purchased from experienced manufactures that specialize in its production and can furnish it more

cheaply and satisfactorily than the owner can otherwise provide it.

Concrete arch bridges invariably have either solid fill or concrete floors, the latter sometimes being carried wholly or in part by steel floor beams encased in concrete. Sometimes concrete arch bridges are provided with reinforced concrete floors carried by steel beams and girders.

CONCRETE GIRDER AND SLAB SPANS

Spans up to 20 or 30 feet, or sometimes even longer, may be made with reinforced concrete longitudinal girders supporting reinforced transverse beams, or concrete floor slabs, all forming a monolithic structure. During construction the forms must be supported on heavy falsework, generally trestle or pile bents, and the concrete should be delivered in a continuous operation until the entire structure is finished, excepting perhaps that hand rails, as in other structures, may be independent members, pre-cast or cast-in-place, or both, as convenient.

Girder spans are seldom as attractive in appearance as arch spans, but can be used where there is less clearance or in cases of minimum height underneath. Where artistic appearance is not imperative, as for instance, in a manufacturing locality, over railroad tracks and over canals, where there is no landscape to consider, they may be cheaper and more economical than arch spans.

For short spans, up to a maximum of 15 or 20 feet, pre-cast or reinforced concrete slabs may sometimes be used to advantage. They can be supported on solid piers or abutments or on trestle bents, the latter being sometimes also pre-cast and erected as separate and independent pieces. In some cases expert skill is necessary for designing the field connections and the joints between different members.

The principal advantages of these pre-cast spans are that they can be erected with considerable rapidity and be ready for immediate service as soon as the erection is completed and considerable economy can be effected by casting them all on the surface of the ground in the contractor's yard. The floor slabs are usually cast in comparatively narrow, long, longitudinal units, two, three or four of which are required to complete the full width of roadway. They may be cast in tiers, allowed to season as long as desired, transported on special or ordinary flat cars, and loaded, unloaded and erected by derrick cars, locomotive cranes, derricks or special gantries or travelers that handle them rapidly and can be advanced as the work progresses, especially if the structure consists of a number of consecutive spans.

MAINTENANCE

All bridges should be periodically inspected and formal reports filed by competent engineers. Occasionally they require special investigation or testing. Repairs should be well maintained, although important ones should not be required for concrete bridges. Repairs on concrete bridges should hardly exceed the necessary maintenance of the roadway and pointing up of temperature or settlement cracks, which are difficult to prevent and which may not at all impair the integrity of the structure.

Steel bridges of all types require thorough inspection at least once or twice a year, and should be carefully protected against overload. The condition of bearings and riveted joints and the adjustments of adjustable members must be carefully observed and great care should be taken to determine the exact conditions of the floor and the principal floor connections to detect any indications of rust, loose rivets, displacements, or settlement of the structure. The bridge should be thoroughly cleaned and painted as often as the paint shows serious deterioration, which may, under unfavorable conditions, be every few months. Especial care should be taken to prevent the collection of water, snow or ice in any cavity or depression, and to protect the under side of the bridge from locomotive blasts beneath it. For this purpose wooden shields are often used.

BRIDGE AT MINELLO, N. Y.
One 90-foot one 100-foot and one 110-foot concrete Melan arch span and steel span over barge canel. Built in 1917 at a cost of $60,000, Concrete Steel Engineering Co.

BLACK RIVER BRIDGE, WATERTOWN, N. Y.
BRIDGE AT MINETTO, N. Y.

Liability of Municipality for Nuisance in Garbage Disposal

By John Simpson

Decisions of various state courts. All hold municipality liable for nuisance, whether or not it is acting in governmental capacity. Decisions differ as to liability of city for nuisance created by contractors for garbage disposal. Positive proof of nuisance required.

In some jurisdictions the creation, maintenance and operation of dumping grounds by municipalities is held to be a governmental duty precluding recovery for negligence in connection therewith, where no nuisance to adjoining owners is created. In other jurisdictions, on the contrary, it is held that the municipality in disposing of its garbage in this manner acts in a private and corporate capacity. In either case the weight of authority is to effect that a municipality cannot without liability create a nuisance by the operation of a dump. This article and the cases cited deal only with the maintenance of a dumping ground, and not with the analagous questions of liability for the pollution of streams by sewage or negligence in the carrying away of garbage.

Although municipal authorities may have plenary power in the matter of collection, removal and disposition of garbage, yet they may not lawfully create in connection therewith a nuisance dangerous to health or life; and where such a nuisance is created and its effect is specially injurious to an individual by reason of its proximity to his home, he has an action for damages. Kea v. City of Dublin, 145 Ga. 511; City of Dublin v. Kea, 20 Ga. App. 718; City of New Albany v. Slider, 21 Ind. App. 392; City of Haskell v. Webb (Tex.), 140 S. W. 125; City of Newcastle v. Harvey, 54 Ind. App. 243; New Albany v. Armstrong, 22 Ind. App. 15; and, when necessary and proper, a court of equity will, at the instance of a citizen suffering special injury from the nuisance, enjoin its maintenance. Bell v. Savannah, 139 Ga. 298, where the city garbage dump was maintained near a thickly settled part of the city, and equipped with railroad tracks, on which cars were left standing all day wholly or partially loaded with garbage.

In Taylor v. Baltimore, 130 Md. 133, it was held that chapter 349 of the Acts of 1904, authorizing the City of Baltimore to erect, and operate and maintain a sewerage disposal and filtration plant extending out into the counties, does not authorize the city authorities to create a nuisance; and if, in the operation of the plant, a nuisance is created, the city is liable to those whose property is injured.

The gathering up off the streets and the premises of private persons of garbage, filth and the like, the accumulation of which would menace the public health, is a governmental duty, and when the city authorities assume to discharge such duty, the corporation is not liable for the negligence of its servants in so doing. But this statement must be qualified to the effect that although in the discharge of a governmental duty it must not commit a nuisance. City of Nashville v. Mason, 137 Tenn. 169. In City of Denver v. Porter, 61 C. C. A. 168, 126 Fed. 288, it was held that "the collection of the refuse or waste material of a city, and the deposit thereof in suitable localities by or under the direction of its agents or representatives, is in the exercise of a proper municipal function. A disposition of the constant accumulation of such materials is not only lawful, but also necessary to the convenience of the public." The maintenance of a public dump on land leased for the purpose from a private owner is not in itself a nuisance. But the establishment, maintenance and operation of dumping grounds for the disposal of refuse, under the direction of officers of the city health department, was held to be a duty of local or municipal concern, not performed in the exercise of any governmental function; and that the city was liable for the negligence of its officers and agents engaged in the performance of the work.

The unsightly appearance of an adjacent lot by the dumping of rubbish thereon is not a cause entitling a landowner to damages. Unless there is injury by gases or something else coming from the city lot on to his premises, he has no right to complain. Lane v. Concord, 70 N. H. 485. But a municipal corporation is liable in damages for injury to real estate where the occupancy thereof is rendered less desirable because of noisome odors emitted from an incinerator plant erected and operated by the municipality near to such real estate, and because of the deposit thereon of ashes and other offensive substances by the incinerator plant. Keene v. City of Huntington, 79 W. Va. 713. A municipal corporation which maintains a rubbish dump in which fire is permitted to smoulder for a long time is liable as for a nuisance to the owner of adjacent property destroyed by fire blown by a high wind from the dump. City of Nashville v. Mason, 137 Tenn. 169. See also City of Denver v. Porter, 126 Fed. 288. It is not necessarily, nor prima facie, an act of nuisance to cast the garbage of a city upon Lake Michigan, fifteen miles from the shore. Kuehn v. City of Milwaukee, 92 Wis. 263.

A city will not ordinarily be liable for the acts of an independent contractor, to whom it has given a contract for the removal of garbage. Where the contract does not reserve to the city the right to control the mode or the manner of its performance or the place where the garbage should be dumped. Kuehn v. City of Milwaukee, 92 Wis. 263. But in Flannagan v. Bloomington, 156 Ill. App. 102, it was held that the fact that a city may have employed an independent contractor to remove garbage and refuse matter from the streets and that he, under his contract, used a place as a dumping ground to the injury of adjacent private property without authority or direction from the city to do so, did

not affect the liability of the city for his actions in carrying out a contract with the city in the execution of the power given to the city to remove and dispose of garbage and refuse matter from the streets.

It has been held, though not necessary for the decision of the case, that if the commissioners of public works had done the work of removing and dumping garbage by their own employees and servants, without the intervention of an independent contractor, the city would not have been liable for an injury growing out of the acts of such employees or servants, for it is a public service, as distinguished from a corporate duty; and that the suggestion that a municipal corporation has no right to create or maintain a nuisance was altogether beside the question involved, because it was not the city, but a larger public, for whom the questionable act was done. Kuehn v. City of Milwaukee, 92 Wis. 263.

The Kentucky Court of Appeals holds, City of Georgetown v. Ammerman, 143 Ky. 209, that a board of health has no power to authorize a city, nor has a city any power to order to be dumped or to dump garbage or other refuse matter so that it will wash into a spring used by the people of the city, or that will create a stench to those persons residing in the vicinity thereof. And in Louisville v. Hehemann, 161 Ky. 523, 171 S. W. 165, the same court holds that notwithstanding a municipality is not liable for its agents' negligence in disposing of garbage, this being the discharge of a governmental function, the municipality is liable for the depreciation in value of adjoining property by permitting its dumping ground to become a nuisance.

In Texas it is held that the construction and operation of a city sewage disposal plant by a city is done in its corporate character for the peculiar advantage of its own inhabitants, and the city will be liable for its torts in that respect, as distinguished from its acts done in the interest of the public at large. Brewster v. City of Forney, (Tex.) 196 S. W. 636. And even where the establishment of a dump yard was held to be a public and not a corporate duty, the municipality would be liable if it negligently permitted the dump to become a nuisance. Ft. Worth v. Crawford, 64 Tex. 202, 74 Tex. 404, or even, it has been held, irrespective of negligence. City of Coleman v. Price, 54 Tex. Civ. App. 39.

But the existence of offensive odors, etc., complained of must appear from the evidence, and as having been caused by the operation of the plant. So, in an action against a city for damages from the discharge from the city's septic tank, it was held proper to refuse a requested special issue in the following words: "Did the filth, stagnant water, flies, any or all of these causes coming from the branch as the result of the defendant's sewage emptying therein and flowing down, in, and around plaintiff's residence, cause him or any of the children to become sick or lose their health?" because it assumed the existence in and around the plaintiff's residence of filth, offensive odors, etc., as the result of the operation of the plant. Brewster v. City of Forney (Tex.), 196 S. W. 636.

If a city, by its ordinance, leaves the place and manner of depositing its garbage to its marshal, or other official, it will be responsible for a negligent performance of the duties thus conferred upon him. So, where a city ordinance provided: "It shall be the duty of the marshal to cause the removal and burial, at the expense of the city, of all carcasses of dead animals the owner or person in charge of which cannot be ascertained," it was held, City of Hillsboro v. Ivey, 1 Tex. Civ. App. 653, that this confided the manner of the performance of the duty to the marshal and the city would be liable in damages for his negligent performance thereof in depositing such carcasses so near a private residence as to create a nuisance thereby.

It does not affect the city's liability that the place where the nuisance is caused by a garbage dump is beyond the city limits. If as a fact it bought land adjacent to a plaintiff's premises upon which to dump its garbage, dead animals and other matter, and so used it, and thereby created a nuisance hurtful and injurious to the plaintiff and his property, its liability would result as if the grounds were situated within the corporate limits. City of Coleman v. Price, 54 Tex. Civ. App. 39.

And where the city scavenger, entrusted by the city with the removal of dead animals, garbage, etc., negligently and repeatedly, through many months and even years, deposits the same near the residence of citizens on land belonging to a nonresident, instead of on the dumping ground provided by the city beyond its corporate limits, it was held immaterial that the land so made the dumping ground of the city was not under the control and did not belong to the city. City of Stephenville v. Bower, 29 Tex. Civ. App. 384.

In Lane v. Concord, 70 N. H. 485, an action against a municipal corporation for creating a nuisance by dumping refuse material upon a vacant lot adjoining the plaintiff's premises, it was incumbent on the plaintiff to establish that the municipality committed the acts complained of, and that such acts wrongfully injured and damaged her in her person or estate; and in the determination of the latter issue, a city ordinance prohibiting the acts complained of was merely competent evidence to be considered by the jury, in connection with all the circumstances of the case, but not conclusive.

The courts will not readily interfere by injunction to prevent the erection or operation of a plant for the reduction of garbage, unless it clearly appears that the plant is constructed or operated so as to constitute a serious nuisance. Baltimore v. Sackett, 135 Md. 56, 107 Atl. 557. A plant for the disposal of the garbage of a city being, like one for the disposal of sewage, essential to the health and comfort of the people at large, an injunction should not issue unless under very extraordinary circumstances, but the party complaining should be left to his or her remedy at law. Taylor v. Baltimore, 130 Md. 146. In a suit against the Mayor and City Council of Baltimore, a prayer asking not only that the defendants be enjoined from hauling garbage to, dumping it upon, or reducing it on a farm, owned by the city, but also from proceeding with the erection of a temporary reduction plant on the farm for the reduction of the city's garbage, and from conveying to this farm all or any portion of the garbage from the city for the purpose of being so reduced, was held too broad and general, and

the injunction was refused. Baltimore City v. Sackett, 135 Md. 56. A municipal corporation was proceeding, under contract with a crematory company, to erect an incinerator, or crematory, for the destruction of the city garbage near the business center of the city, on a guaranty by the company that the plant, when completed, would consume the garbage without offensive odors, etc. The construction of the garbage plant had proceeded to within two days of completion when an equitable petition was filed by residents living within 100 yards of the crematory to enjoin the further progress of the work because of the offensive odors, gathering of flies, etc., which it was alleged would be caused by the hauling and dumping of the garbage. It was held that, there being evidence from which the jury could find that there were other available vacant lots in a different and more remote section, away from the heart of the city and the residential section thereof, and that the hauling of the garbage near the petitioners' residences would cause flies and noxious fumes and poisonous gases emanating from the garbage to pester the petitioners and depreciate the value of their property, a verdict enjoining the completion of the crematory was authorized. Quitman v. Underwood, 148 Ga. 152, 96 S. E. 178.

Certain residents of a city living on a bluff filed a bill in equity against the proprietor of a garbage furnace situated on the river bank at the base of the bluff, complaining of annoyance by odors from the garbage before it was put into the furnace, which was of the best and most approved construction, and was operated under a contract with the city, on a site selected by the city authorities. The evidence tended to show that the site was probably the best for the purpose anywhere within, or in the neighborhood of the city. The court refused to enjoin the operation of the furnace, but decreed that the garbage should be placed in the furnace as soon as possible, and that the residuum should be shipped off as speedily as possible. The Pennsylvania Supreme Court, on appeal, Fisher v. American Reduction Co., 189 Pa. 419, held that the decree was a proper one under the circumstances.

In such cases the doctrine of contributory negligence has no application, so that it is no defense to an action against the city for permitting garbage and refuse emitting noxious odors to be dumped in a street near the plaintiff's premises that the plaintiff caused garbage and refuse to be deposited on his premises. Correll v. City of Cedar Rapids, 110 Iowa 333.

If an incinerator plant, or other garbage disposal plant, is one of the instrumentalities constructed by the city for the purpose of carrying out its legitimate powers, and is fit to be used for that purpose as a permanent structure, and the damage to adjoining real estate from noxious odors and the deposit of ashes and other offensive substances results from the construction and proper operation of the plant, the injury is a permanent one, and the measure of damages is the diminution in the value of such real estate by reason of construction and proper operation of the plant. But if the injury arises solely from the negligent or improper operation of the plant, such injury is of a temporary character, and damages therefore must be recovered in successive actions. Keene v. City of Huntington, 79 W. Va. 713.

When the deposit of garbage on land causes no permanent injury to the soil, and there is no evidence that the odors created by it will be permanent, no recovery can be had for loss on the ground of permanent injury to the property. Where the injury is not permanent, the measure of damages is the difference in the rental value of the property with and without the nuisance, with any incidental damages such as the cost of removing the nuisance and of taking care of the premises when not rented because of its existence there. City of San Antonio v. Mackey, 22 Tex. Civ. App. 145.

A complaint for damages and to enjoin the pollution of the plaintiff's fish pond, caused by dumping garbage where it polluted the stream which fed the pond, must aver that at or prior to the bringing of the suit the city allowed or permitted the refuse to wrongfully, negligently or carelessly escape from the dumping ground to the plaintiff's injury. City of Newcastle v. Harvey, 54 Ind. App. 243.

Present Status Activated Sludge Process

Brief description, from personal inspection of English and American plants. Description of experimental plant embodying new ideas recently constructed by the Illinois Water Survey Division.

In a paper prepared for the American Society for Municipal Improvements, Edward Bartow, head of the chemistry department, State University of Iowa, has summed up briefly the present status of the so-called activated sludge process of treating sewage, describing at some length the plant recently installed by the Water Survey Division of Illinois at Urbana for experimental purposes. Mr. Bartow has recently visited activated sludge installations in England as well as in this country.

The Houston, Texas, plant is the largest in the world that has been in successful actual service. It consists of aeration chambers, settling tanks, and large air compressors in a building at one end of the tanks. On a hill above the plant are buildings in which sludge pressing and sludge drying experiments are being made. The effluent obtained has been very satisfactory but no definite plan has been decided upon for de-watering and drying the sludge, which up to this time has been disposed of by lagooning.

The first plant of any size was that built in Manchester, England, in 1914, and this is still

operating on the fill-and-draw system with a daily capacity of about 50,000 gallons. As a result of experiments with this plant the city of Manchester constructed a plant on the continuous flow plan with a capacity of about 500,000 gallons. In the latter plant the sewage passes five times the length of the tanks and the sludge is returned through a pipe to the point where the sewage enters the plant. The mixed sewage and sludge passes to the center of the settling basin and the clear effluent flows out over the edges of the tank at the corners in order to prevent short circuiting. Results with this plant were so satisfactory that a much larger one has been constructed at Davyhulme where the sewage and sludge passes three times the length of the tank and the sludge returns to the entrance in an open channel having half the width of the aerating channel. For experimental purposes two kinds of settling tanks have been constructed, one for gravity separation with a bottom sharply sloped so that the sludge may settle to the center of the hopper and be removed by gravity; the other having a circular bottom sloping only slightly and a collecting mechanism to carry the sludge to the center for removal.

Worcester, England, has also been successful with a small plant and will probably adopt the activated sludge process for treating all its sewage. During the war several small plants were constructed at hospitals and munition plants. One at Blackpool takes care of the sewage from a munition plant employing 3,000 men.

In the United States most of the activated sludge plants are experimental except that at Houston. Following experiments by the Sanitary District of Chicago and by Milwaukee, both of these have adopted the process for large plants, the former having a large unit under construction at Maywood, and a large plant will be built to dispose of the waste from the stock-yards and another in the Calumet district.

Milwaukee is still endeavoring to solve the problem of sludge drying in order to decide upon the best design for the service plant for the city. The Milwaukee Sewerage Commission has spent much time and energy in an effort to solve the sludge problem and at present is experimenting with a continuous centrifugal machine which it is hoped will prove satisfactory and successful. Aside from the centrifugal machine, plate pressing seems to be most promising.

The state water survey division at Urbana with a small appropriation has established an experiment station which is being put in operation at the present time. In this it is proposed to have a plant as complete as possible. It will have approximately 100,000 gallons daily capacity and will include screening, aeration, sludge de-watering and drying.

The sewage flows by gravity through the grit chamber to a screen furnished by the Dorr Company of New York. After screening, the sewage passes to the pump pit from which the screened sewage is pumped to the aeration tanks. By use of screened sewage trouble from stoppage, which often occurs when unscreened sewage is to be handled, is avoided. The activated sludge plant itself contains two tanks 17 feet in diameter and 13 feet in depth. The sewage may pass through in series or in parallel. It is expected to use the plant in a manner similar to that used by the Dorr Company, in an experimental plant at Mount Vernon, N. Y.* About half way between the top and bottom of the tank is a tray inclined slightly upward toward the center. Air is forced in through filtros plates at the bottom and is caught and carried to the center of the tank under the tray. The air rises through the central well and is returned with the incoming sewage through another well to the lower compartment of the tank where it is carried by a revolving mechanism to the outside toward the outer rim of the bottom of the tank where it passes over the plates and is caught up by the air and carried with the air to the top, thus completing the circuit.

At the top, part of the mixed sewage and sludge passes over an adjustable collar into the upper part of the tank, which is a settling compartment. The clarified liquid passes over the outer edge into the trough from which it passes to a second tank or to a stream. The sludge is carried by another mechanism to the outside of the upper chamber and flows by gravity through down-cast peripheral wells into the lower chamber, where it is mixed with sewage and air and enters the aeration circuit.

We thus have two circuits; one for sewage, sludge and air and the other through the sedimentation section of the tank for the sludge alone.

It is hoped by this method to demonstrate what was shown by the Mount Vernon test, that the amount of air used can be greatly reduced.

The two important problems of the activated sludge process which have not been satisfactorily solved are the amount of air used and the drying of the sludge. By the Dorr-Peck process, it is proposed to reduce the amount of air. Two other proposed methods should be mentioned, both English. In one it is proposed to use the air intermittently. Sufficient air will be added to saturate the mixture of sewage and sludge, then the addition of air is discontinued for a while until the air is used up. In the other, the scheme which has been adopted for the new plant at Manchester, the air comes in at one side of the long tank and is expected to cause the sewage and sludge to circulate in a direction horizontal to the line of flow through the tank. The portions of the tank at the sides farthest from the aerating plates have a curved bottom and it is expected that the circulation will be such that the amount of air required will be greatly reduced.

The other problem not satisfactorily solved is sludge drying, and it is my thought that many cities that have been considering methods of sewage disposal have hesitated to adopt the activated sludge process because of the difficulty in disposing of the sludge. Because of the expense, engineers have advised against its adoption by several cities. Where possible, if the amount of air could be decreased and the sludge satisfactorily dis-

*This was described in Public Works for January 15, 1921.

posed of, the method might be found the most satisfactory and the cheapest.

For the final drying, aside from attempts to dry the sludge on sand beds, most attempts have been made by direct-heat driers. Recently, the Bailey Mfg. Company in Milwaukee has designed an indirect-heat drier which is to be tried out at the sewage testing station at Urbana. In preliminary tests with this drier, a sludge with less than 10 per cent moisture was obtained from sludge having originally nearly 90 per cent of moisture. There was no unpleasant odor and no dust noted during the process. Drying without odor or dust has not been accomplished with direct-heat driers and it is hoped that the expense of the indirect-heat driers will not be too great and that it may solve the problem of sludge drying.

Substitutes For Sewers*

By W. A. Hardenberg

Use of septic closets, chemical toilets and small septic tanks. Comparison of annual costs of the chemical types.

THE SEPTIC CLOSET

The septic closet has been used a great deal, especially in the south in industrial and mill villages as well as in many of the smaller towns. The fact that it has not lived up to its advance notices can be charged to commercial interests very largely, though the lack of proper care and maintenance have been important items. This type has been pushed very widely by several manufacturers and in the intense competition, extravagant claims have been made and occasional shoddy work has been done.

The septic closet is also known as the L. R. S., from the initials of its originators, Drs. Lumsden, Roberts and Stiles, of the Public Health Service. Its action is generally the same as that which takes place in a septic tank. The needed water is added daily or weekly by means of buckets. The effluent passes out through an open-joint tile line and is disposed of by means of sub-surface irrigation.

The seat lid must be kept down to exclude flies; kerosene oil must be used in the summer to prevent mosquito breeding; the water must be added regularly and in sufficient quantity. If these precautions are observed, very good service is obtained from this type of installation. There is considerable odor in hot weather, and the effluent is discharged into the soil in such fashion as to promote ground water pollution, but these are really secondary considerations in comparison with the health protection that such an installation gives.

The septic closet is manufactured widely and can be bought for about $38 to $40, exclusive of the house; or most anyone at all familiar with concrete can manufacture one for himself. As the "Kentucky sanitary privy," the fame of this type has been heralded far and wide. Plans are available from almost any county or city health officers, and from all state health offices. The cost of the home-made type will average about $35.

The capacity or size of the septic closet is important. North Carolina now requires a capacity of 200 gallons minimum, and this is about as small as should be used. Of equal importance is careful installation. The disposal tile should be laid to grade and line, the tank placed level, and on a good foundation.

The septic closet is an outdoor installation, and experience has shown that these are rarely satisfactory for thickly settled communities for any great length of time. It is generally poor economy to use them in city sanitation. The fairly large first cost, though followed by low maintenance costs, is really too great in view of its temporary character.

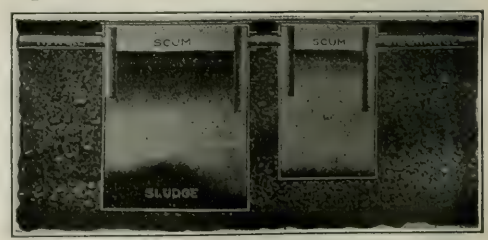
THE CHEMICAL TOILET

This outfit is built in two types, the commode, and the storage system. The former is unsuited for use in urban districts, as it is merely a metal box and can to which chemical is added. In fact, the only real field for the commode is as a convenience in the country or rural sections. The storage type is equipped to care for the sewage from a family for from four to eight months without scavenging. It has the advantage of indoor installation and is perhaps the best, though rather costly, substitute for running water.

It consists of a metal tank, protected against the action of the chemical and of sewage, a china bowl, a connecting tube and adequate ventilation. The tank is charged with a small amount of chemical—about 15 gallons of solution—which is usually caustic soda. This breaks up, deodorizes and sterilizes the sewage. The cost of operation averages about $5 per year, but the first cost is rather high, from $60 to $80. Scavenging is made easy by providing an underground pit into which the tank contents may be turned by opening a valve.

SMALL SEPTIC TANKS

Where running water is at hand, but no sewers, houses may have plumbing installed and the sewage carried to small septic tanks for treatment, as was mentioned in this magazine a short time ago in connection with Baltimore. The small septic tanks work very efficiently and will care for the sewage of the average residence with a minimum of attention and cost. Economy in first cost may often be attained by combining the flow from two or more houses and installing a larger tank.



A COMMERCIAL METAL SEPTIC TANK, RESIDENCE SIZE

*Continued from page 296.

The capacity required in these small tanks is roughly from 20 to 30 gallons per capita, but almost every state board of health has its own requirements, and these should be followed. The cost will run, for the smaller tanks, about 30 cents per gallon, and for the larger ones about two-thirds as much. Concrete tanks are used to a large extent, both built in place and pre-cast. Of late the metal tank has come into favor. Among its advantages are the ease of handling and the fact that it may be dug up and moved if desired. It is also a little cheaper than the concrete tank.

The matter of the disposal of the effluent is a very important one. Sub-surface irrigation is one of the methods applicable, but local conditions will govern this point. If metal tanks are used these may be dug up when sewers are extended to that section, and used in another place, meanwhile using the sewer from the house to the septic tank as a house connection for the sewer.

COST

A rough estimate of cost has been given along with the description of each type. To correctly estimate the cost of each method of disposal requires the consideration of first cost, annual cost, maintenance and operating expenses.

With the exception of the pit and the wooden box and can outfit, the other types described in the preceding pages are fairly long-lifed. This may or may not be an advantage, depending upon the length of time that may intervene before sewers are constructed. However, it is hardly fair to the more durable types to compare them in regard only to first cost. For that reason there is given herewith a basis of costs for a ten-year period.

Type of Disposal	Installation	Int. and Maint.	Scavenging	Total Cost	Annual Cost
Pit	$60.00	$19.80	$36.00	$115.80	$11.58
Box (wood) and can	24.00	10.02	70.00	104.02	10.40*
Concrete vault....	35.00	21.00	60.00	116.00	11.60
Commercial L.R.S.	38.50	23.10	20.00	81.60	8.16
Home-made L.R.S.	35.00	21.00	20.00	76.00	7.60
Chemical toilet....	65.00	39.00	50.00	154.00	15.40

*Does not include share of disposal expense, as purchasing land for burial, etc.

The above are on the basis of 10 years' service. In this time the pit would have to be cleaned ten times; the box and can (wooden) would have to be replaced at the end of five years with a complete new installation, as its life is only about 5 years, and the cans renewed every two years. All the other installations are durable and permanent.

The question of housing also affects the cost. In the above table, this cost for housing should be added to the cost of the pit, the box and can, the concrete vault and the L. R. S. type. The annual cost would be about $3, but this has been omitted from the table because it is often the case that the old house can be adapted for use.

To the above costs given for the septic tank, when used with running water should be the expense of putting plumbing into the home—at least $125—and the annual cost of water, $6 to $10.

The scavenging cost for the chemical toilet includes the cost of chemicals. The scavenging cost for the L. R. S. will depend largely upon the use given them. If abused, it may be necessary to clean them every 6 to 12 months. Otherwise, biennial cleanings will be sufficient. The scavenging cost for the box and can is assumed on the operation by the community of a fairly efficient and sanitary scavenging force.

When these points are all included it may very often be open to question as to whether extending the sewers may not be the cheapest way out of the situation. However, if this cannot be done—and there are many places where it cannot—any of the above methods will be a vast improvement over the lack of method usually found in the average city's unsewered area.

Non-Rigid Base for Granite Blocks

The Department of Public Works of Providence, R. I., relaid a considerable yardage of old granite block pavement, part of which had been laid originally on a six-inch cement-concrete foundation and part on a rolled broken stone base. Much of the pavement had settled in places after carrying considerable traffic. In relaying that laid on a broken stone base, the old base was replaced with one of asphalt macadam.

The first step was to take up and clean the old blocks thoroughly, no recutting being necessary. The sub-base was of gravel, varying in thickness up to 8½ inches. This sub-base was rolled thoroughly, and on top of it was placed 2-inch trap rock which was rolled to an average depth of three inches. Smaller size trap rock was spread and rolled to fill the larger voids.

This stone was then given a penetration treatment of No. 96 Texaco asphalt, using about 1½ to 1¾ gallons per square yard. Stone chips were then spread and the base was rolled. Following this, a sand cushion one inch or more in depth was spread on the asphalt macadam base, and on this cushion the granite blocks were relaid.

After the blocks had been laid and a small amount of stone chips had been swept into the interstices, the joints were filled with asphalt. Sufficient asphalt was spread so as to slightly flood the surface of the blocks for about one-third their area.

After the asphalt filler had been applied, the surface was covered with clean stone chips and rolled, after which the street was open to traffic.

The engineers in charge are thoroughly pleased with the results, and the street offers an excellent thoroughfare for heavy traffic with a minimum of noise.

Modern Road Building and Maintenance

Andrew P. Anderson, highway engineer, Board of Public Works, United States Department of Agriculture, has prepared a resume of principles and practice for the use of engineers, contractors, road officials, students and others interested in the rational and economical solution of problems connected with public roads and traffic.

The book has 146 pages besides a number of half-tones and nine drawings, is well printed in large type, is bound in stiff paper covers. It has sections on planing the road, road materials, road construction, road maintenance and repairs, and the use of explosives.

It is comprehensive and carefully written with many valuable and convenient data, with a section treating of road construction which occupies about one-half of the volume and is divided into fourteen chapters on organization and equipment, clearing and grubbing, drainage, quarrying and stone crushing, earthwork, bridges and culverts, bituminous surface application and the principal types of road surfaces, namely earth, sand-clay, gravel, water-bound macadam, bituminous, concrete and brick.

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems different will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

What Are the Advantages, Disadvantages and Uses of Limestone in Highway Construction?

Widely distributed, easily obtained, and has a large range of characteristics. Many varieties are acceptable for masonry and for concrete stone; some for macadam surface under light traffic. Has great cementitious properties, but is generally not tough or hard enough for macadam surface.

St. Louis, Mo.,
March 23, 1921.

GENTLEMEN:

As I am interested in municipal improvements I receive a great many ideas from reading PUBLIC WORKS.

Noting your ad on page 40 of your March 12 issue I take the liberty of asking for information on "The Use of Limestone for Road Construction," its advantages and disadvantages.

Any data you can give me will be greatly appreciated and I thank you for your courtesy.

Yours very truly,

* * * * *

In the United States limestone is abundant east of the Rocky mountains and its principal varieties include Chazy, Chiteau, Black River, Helderberg, Keokuk, Niagara, Onondaga, St. Louis and Trenton, most of the names indicating the locality where it is found.

The properties of limestone vary greatly with its composition and the locality in which it occurs. The compressive strength varies from 3,000 to 25,000 pounds per square inch, hardness is about 3.55 to 4 for dolomite in a scale reaching from 1 for talc, the softest, to 7 for quartz, the hardest, rocks being classed hard at 6.

In general the qualities of limestone vary greatly with its composition. The texture may be coarse or fine, it may be granular, oolitic, or crystalline, and it may be hard and compact, brittle and vitreous, well or loosely cemented or friable. There are, of course, corresponding variations in the hardness and durability, some specimens having a higher resistance to crushing and greater durability than others. It is generally lacking in the extreme hardness and toughness possessed by some other rocks, notably trap rock, but is an excellent binder for macadam road. When quarried it usually breaks into irregular fragments that, in loose heaps, have about 50 per cent voids. Broken stone for macadam and concrete can be made from the run-of-quarry or from the waste of cut stone, by crushing it in gyratory or jaw machines. The former are generally more massive and are mounted stationary, while the latter are used more for portable installations.

The broken stone is accurately graded in size from a diameter of ¼ inch to 3 inches by passing it through revolving cylindrical screens. Smaller particles, called screenings, and stone dust are saved for surface dressing of roads and have a high cementitious value. Except in a few cases where very large crushers are installed, stones of more than one or two cubic yards volume are drilled by hand, by jack hammers or by other small machines and blasted into smaller fragments easily received by the rock crushers.

At the crushing plants the broken stone is often hoisted by bucket elevators to storage bins, from which it is delivered by gravity to cars, trucks, boxes or buckets, and transferred to the concrete mixer or to other places where it is used. A complete line of mechanical plant and equipment has been developed and is on the market for quarrying, cutting, crushing, sorting, handling, storing and transporting stone for road construction and other purposes.

GENERAL USES

Limestone can be used in road construction for various purposes. Large and dimensioned pieces with rock face or hammered surfaces are suitable for ashlar or rubble masonry. When broken or crushed to diameters of 3 inches or less it is used for foundations for pavements and macadam surfaces, and for concrete.

Well-selected limestone of the harder and denser varieties is satisfactory for foundations of all sorts, bridge piers and abutments, retaining walls, culverts, arches, parapets and the like, both for rubble and ashlar work. For most of these purposes, however, concrete is used much more extensively than either coursed or random masonry and for it nearly any good quality of limestone is suitable. Its selection, however, depends on the cost and facility of production and transportation and on the relative cost, adaptability and abundance of other kinds of stone, such as granite, quartz, sandstone and other varieties. Good sound limestone is suitable for the foundation courses of all kinds of roads and pavements and under favorable conditions crushed limestone makes satisfactory wearing surface for waterbound macadam or bituminous macadam roads.

It is, however, likely to be not sufficiently tough and durable for the wearing surface, which can generally be much more advantageously made with trap rock.

Limestone will, however, under favorable conditions, make an excellent wearing surface for light traffic and its very cementitious qualities secure a high degree of water tightness, very desirable in the road bed. Even if the limestone is too soft for the best road surface, it may be advisable to use it rather than import harder stone at a much greater cost. Dolomitic limestone is better than ordinary limestone for road surface. The presence of clay in limestone improves its road qualities and the presence of sand impairs it. A covering of iron ore on a limestone road surface greatly improves it.

Crystalline limestone is unsuitable for road surface because it has a tendency to be quickly broken and ground into dust. Calcareous limestone is also objectionable because it is to a considerable degree soluble, both in rain water and in acidulated water.

Waterbound limestone macadam roads are those in which the upper course of broken stone is compacted by the stone dust and fine particles cemented together, making a surface that, although not very durable, is attractive for light traffic, but is subject to a large amount of dust in dry weather and mud in wet weather, objections that do not obtain with bituminous macadam.

Limestone is soft and wears so unevenly that it does not make satisfactory block pavements, which in a year or two become split and worn and have to be replaced.

REQUIREMENTS AND TESTS FOR MACADAM STONE

The principal requirements for broken stone for road buildings are hardness, toughness, uniformity of wear, maintenance of rough surface, and cementing qualities. The toughness is promoted by fine grain and by the presence of quartz or hornblend. Solubility and the presence of carbonates tend to produce irregularity of wear. The maintenance of a rough wearing surface under traffic and weather conditions requires coarse grain. Durability requires hardness, toughness, sharpness and stability. Cementing qualities are generally due to oxide of iron, lime or clay.

The different qualities of limestone can be predetermined by laboratory tests of specific gravity, abrasion, impact, toughness, compression, weathering and by chemical and microscopic analysis, or they can be demonstrated by service tests in the actual road traffic.

PRACTICAL CONDITIONS

Broken stone in the macadam road surface deteriorates through the direct grinding action of steel tires, through the removal of the screenings and cementitious materials by suction and wind caused by automobile tires; by the impact and abrasion of horses' hoofs, by the grinding and breaking of pieces of stone below the surface of the road displaced by heavy pressure and concentrated loads, and by atmospheric causes, such as rain, snow, freezing and thawing.

Generally limestone is neither hard enough nor tough enough to stand abrasion and impact satisfactorily, especially under heavy traffic. This prevents it from being first-class material for waterbound macadam, but is somewhat less disadvantageous for bituminous macadam. The lack of toughness and hardness is also objectionable, although in a less degree in broken stone for concrete pavements where all the pieces are firmly held and the wear is only on the upper surface. Hard, sound limestone may be acceptable for this purpose, but is inferior to granite or trap rock.

Broken stone for road surface must, of course, conform in size to the specification, but these are likely to require for road concrete, 1½-inch stone, sometimes with the smaller pieces eliminated, but more often with them left in, so as to virtually constitute run-of-crusher with dust sifted out, thus leaving enough small fragments to fill the voids and make it as dense as possible, and increasing the strength and reducing the amount of sand, cement, and the total cost.

Macadam pavement foundation course, 4 inches or more in thickness, is made of stone usually from 1½ to 3 inches in diameter, for which good limestone containing not more than 30 per cent lime is entirely suitable.

A second course of about the same thickness is made of smaller stones, usually about 1½-inch diameter and under. This course is finished with a surface dressing of screenings or other binding material. For the top course trap rock is usually considered the best, but for light traffic the Tompkins Cove limestone, that breaks into almost cubical fragments and has great cementitious properties, or stone with similar characteristics but a different local name, is satisfactory, making a very smooth, compact road with a very pleasing surface for vehicles, but which wears rapidly.

A Workable Form of Contract*

By John Lyle Harrington

A great deal of work was let during and since the war on cost-plus-a-percentage basis, but the facts and the suspicions regarding wastefulness disclosed by the congressional investigations have led the public to be violently opposed to that form of contract at the present time. Recently I have had several clients absolutely refuse to consider such a form. It is true that the large majority of contractors are honorable business men who will carry out work under such a contract with fidelity, thoroughness and economy, but the innocent suffer with the guilty and I am afraid that for public work particularly that form will find small favor in the near future.

At the beginning of the construction of this country's public and quasi-public works the practice became established of drawing contracts entirely in favor of the owner. Some eminent engineers boasted that they always broke the contractor on their jobs and the contractor in turn took pride in skinning the job.

*Excerpt of paper presented to New Orleans convention of Associated General Contractors.

It has also been the custom of the owner to place upon the contractor, not only the responsibility for his own skill and management, which is right, but the responsibility and risk arising out of hidden conditions—floods, fires and other contingencies—and in his anxiety to secure the work the contractor, to his cost, often minimized these risks in making up his bid. I think the time has come, however, when the owner must share those elements of cost which cannot be foreseen, such as foundation conditions which are not fully disclosed by the borings, loss from flood and fire.

COST-PLUS-A-FEE CONTRACT

Early in the war period we worked out a form of cost-plus-a-fee contract which has been giving satisfaction to both parties. The specifications clearly define what shall be included in the cost estimate and what in the fee, and give an approximate estimate of quantities. The contractor then presents an estimate of cost, a bid fee, unit prices to be applied to the actual quantities in order to correct the estimated cost when the work is done, a statement of his experience, of his organization, of his equipment, and his financial ability, and the work is let to the contractor whose total estimated cost, plus his profit fee, amounts to the smallest bid, provided he is possessed of the experience, the organization, the equipment and the financial ability to carry out the work. If the corrected estimated cost, made up when quantities are known, is exceeded by the actual cost, each party bears one-half the excess cost until two-thirds of the contractors' profit fee are absorbed; the remaining one-third being considered substantially sufficient to cover certain items which enter into his profit fee. If the corrected estimate cost be less than that used in the bid, each party shares the saving.

This form provides the same character of incentive for efficient and economical work that would be present in a straight unit price contract, though its extent is diminished and so far it has worked out very satisfactorily though it places more labor upon the engineer.

Engineers and Contractors*

I think I know of one way in which the engineer can be very helpful to himself, his clients and to the contractor (and avoid the bad influence of the lawyer)—and this is to make these investigations very complete, to remove doubt and uncertainty to the greatest extent possible, that they shall draw contracts that will provide payment of items for any part of the work that can be reasonably segregated.

You know, it is quite the habit to set forth the main items of the contract and then for all minor things to say that they are included in the payment of the other items of the contract. I don't think that is fair. I don't think it is necessary, and the only excuse for using contracts of that sort is either laziness or incompetence on the part of the engineer. Also the work under each item, how it is to be measured and paid for; provide a reasonable elasticity.

This is sometimes very difficult because under some legislation and rules it is not allowable to put in the contract any provision for doing the so-called extra work or work which could not by any means have been foreseen when the contract was drawn. That is, I believe, wrong, but one must follow the law and there are still ways of getting around that difficulty. But the work upon which no direct payment is made, but includes the other items of contracts, should be reduced to a minimum.

Lastly, the difficulties surrounding the work should be set forth as clearly as possible, either in the contract document itself or by the engineers in charge of the work, at the time the contractor looks it all over with the view of bidding. Believing that the contractor on public work is just as much a partner in the undertaking as the engineer representing the governmental authority, an effort should be made to establish better working basis between the engineer and the contractor, working together to bring about a more perfect result and this in the end will reduce expense and litigation.

I heard a man say of a contract to-day, "Well, that's a pretty tough job, but that man S——— is so very thoughtful that whenever he asks me to do anything, I'll be d——— if I don't do it!"

Co-operation will bring about a feeling of that kind. In order that the elements of doubt and uncertainty attending most forms of contract work may, to the greatest extent possible, be eliminated, it should be the aim to make preliminary investigations as complete as possible and prepare plans and specifications as complete and definite as the best thought can make them, which will give all available and certain information so that the contractor can prepare an intelligent bid and accurately estimate the business risk involved.

All this would, in my judgment, stimulate competition, bring better and fairer prices and ultimately secure a more satisfactory result and greater economy.

*From address by J. Waldo Smith before Associated General Contractors.

Masonry Structures

This book by Frederick P. Spalding, professor of Civil Engineering, University of Missouri, is designed to briefly present the fundamental principles involved in the design and construction of masonry structures. It outlines early and modern development with a complete review of lime, hydarulic cement, cement specifications and tests, sand mortar and gypsum plasters.

The qualities and production of building stone, construction of stone masonry, its strength, measurements and costs are presented. Building bricks, terra cotta, gypsum and brick masonry are also discussed. The discussion of concrete includes aggregates, proportioning, mixing, placing, strength, durability, permeability and cost of plain concrete and the general principle, designs, formulas and tables for reinforced concrete beams, slabs and columns.

Analysis and classifications are given of retaining walls, straight and curved dams, slab and girder bridges, arches, culverts and conduits, and foundations with principles of design and computation, graphical and mathematical analyses, requirements of loading and service and construction methods and auxiliaries including sheeting, piling, open and pneumatic caissons, dredged caissons, and various other practical features of the work.

Recent Legal Decisions

ENGINEER PROPERLY EMPOWERED TO SEE THAT SEWER PROPERLY CONSTRUCTED—PUMPING STATION FOR SEWAGE SUBJECT FOR SPECIAL ASSESSMENT

In proceedings by a city to confirm a special assessment to pay the cost of a sewer district, objected to by owners of property, it was held, City of Nokomis v. Warsing, Illinois Supreme Court, 129 N. E. 71, that the ordinance providing for the creation of the district was not subject to the objection that it vested in the engineer a discretion as to the manner in which the improvement should be constructed or as to the material used. It described the improvement and the kind of materials to be used. Only supervisory powers were given the engineer in seeing that the work and materials were in accordance with the requirements of the ordinance. This was held not improper. The same court has held, Geyer v. City of Rock Island, 215 Ill. 144, 74 N. E. 105, that giving the engineer discretion to make a small change in some respects will not render the ordinance invalid. The ordinance provided for a pumping station for sewage, and it was claimed that this is not a local improvement, and cannot be constructed by special assessment. The Illinois court has held otherwise in Fisher v. City of Chicago, 213 Ill. 268, and Drexel v. Town of Lake, 127 Ill. 54.

PROOF OF ACCEPTANCE BY MUNICIPALITY OF DEDICATED STREETS

The New York Court of Appeals holds, Johnson v. City of Niagara Falls, 129 N. E. 213, that streets and roads dedicated by individuals to public use but not adopted by the local public authorities or declared highways by statute are not highways within the meaning of the highway acts; and there is no law by which anyone can be compelled to keep them in repair. The mere fact that a portion of the public have traveled over a road for 20 years would not make it a highway; but the use must be like that of highways in general, and the road must not only be traveled upon, but it must be kept in repair, taken in charge and adopted by the public authorities. People v. Underhill, 144 N. Y. 316, 39 N. E. 333. An intention by city authorities to accept a lane north of certain railroads in a city without formal action should not be presumed where the city has accepted land south of the railroads by specific and formal action. Isolated acts of the street department in filling holes in the claimed street are insufficient to show acceptance by the city, and the mere filing with the assessors by the owner of land of a map showing a street thereon is wholly immaterial on the question. The mere assessment by assessing officers of lands which they describe as being on a so-called street named by them is no evidence of a proper acceptance of such so-called street. And the mere omission of a municipality to assess land dedicated by the owner for a street is not alone sufficient evidence to sustain a finding of an acceptance by the municipal authorities of such land as a public street.

AUTHORITY TO MAINTAIN WATER WORKS INCLUDES POWER TO SUBSTITUTE ELECTRIC FOR STEAM PUMPING PLANT

The purpose of the Arkansas statute, Kirby's Dig., Par. 5675, authorizing a city to operate and maintain water works constructed by improvement districts, was to authorize the city council, after the water works had been constructed and turned over, to perpetuate the same by having the city maintain it up to a standard of efficiency. This would necessarily involve the repair of the plant and the renewal of parts which became worn out and in disrepair. There is nothing in the language which compels restriction of the repairs to a reconstruction in identical form in which the water works were originally constructed. Looking at it from a practical standpoint, what the statute requires is that the water works shall be kept up to the established standard, and that the city shall have control over it to determine in what way that standard of efficiency shall be maintained. The Arkansas Supreme Court holds, Arkansas Light & Power Co v. City of Paragould, 225 S. W. 435, that the city's authority under the statute gives it power to contract for the installation of an electric pumping plant in place of the original steam pumping plant, which was not to be sold, but was to be retained as an emergency plant. The fact that such a contract based the compensation on the current rates charged for the water does not invalidate the contract as a restriction on the city's right to change its rates, the contract having been made with relation to that right; and the power company with which the contract was made could not object to a change of rates unless it was deprived of reasonable compensation.

MATERIALMEN'S RIGHT OF ACTION ON PUBLIC WORKS CONTRACTOR'S BOND

The right of action provided by the Florida statute, Chap, 6867, Laws of 1915, in behalf of any person, firm or corporation supplying labor or material to a contractor or sub-contractor engaged in the construction of public works is secured only when a bond of the contractor is filed containing the additional obligations required by the statute that the contractor or contractors shall promptly make payment to all persons supplying him or them with labor and material in the prosecution of the work provided for in the contract. A bond filed which does not contain such obligation, but does contain a condition that he will carry out all the terms of the contract, which contract contains a clause that the contractor will pay all just claims for materials and supplies that may be incurred by him in the performance of the work, is not such a bond as is required by the statute to protect third persons from whom the contractor or sub-contractor may obtain materials or labor, and no right of action is secured to such persons against the contractor and his sureties thereby.—J. B. McCrary Co. v. Dade County, Florida Supreme Court, 86 So. 612.

NEWS OF THE SOCIETIES

Apr. 25—CHICAGO SECT., AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Joint meeting with ELECTRICAL AND MINING SECTIONS WESTERN SOCIETY OF ENGINEERS and ASSOCIATION OF IRON AND STEEL ELECTRICAL ENGINEERS.

Apr. 27—AKRON SECT., AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with Engineering Society of Akron.

April 27—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual convention. Houston, Texas.

Apr. 27-29—BUILDING OFFICIALS CONFERENCE. Cleveland, Ohio.

Apr. 27-29—SOCIETY OF INDUSTRIAL ENGINEERS. Milwaukee, Wis.

April 27-29 — UNITED STATES CHAMBER OF COMMERCE. 9th annual meeting. Atlantic City, N. J.

Apr. 27-29—BUILDING OFFICIAL'S CONFERENCE. Seventh annual meeting. Cleveland, Ohio.

Apr. 28-29—MID-CONTINENT SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting of Chemical Eng. Societies. City Auditorium or Convention Hall, Tulsa, Okla.

Apr. 29—ST. LOUIS SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. American Hotel

Apr. 29—NATIONAL HIGHWAY TRAFFIC ASSOCIATION. Annual meeting, Detroit, Mich.

April 29 — EASTERN NEW YORK SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Edison Club Hall, Schenectady.

April 29 — COLORADO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Metropole Hotel.

April 29—SAN FRANCISCO SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

May 2-4 — MISSISSIPPI VALLEY ASSOCIATION, 3d annual convention, New Orleans, La.

May 4-7 — NATIONAL FOREIGN TRADE CONVENTION. 8th convention. Cleveland, Ohio.

May 5—BALTIMORE SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with the Engineers Club of Baltimore.

May 5—ROCHESTER SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint dinner of the professional engineers of Rochester. Powers Hotel.

May 6 — VANCOUVER SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

May 9 — HARTFORD BRANCH, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Get-together dinner at City Club.

May 9-11 — AMERICAN ASSOCIATION OF ENGINEERS. 7th annual convention. Buffalo.

May 9-12 — SOUTHWEST WATER WORKS ASSOCIATION. Shirvin Hotel Headquarters, Oklahoma City, Okla.

May 10-12 — CANADIAN GOOD ROADS ASSOCIATION. 8th annual convention. Halifax, Can. Secretary George A. McNamee, Montreal.

May 17—CLEVELAND SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual dinner.

May 17-19—NATIONAL FIREMEN'S ASSOCIATION. Twenty-third annual convention. Fort Wayne, Ind.

May 18—BIRMINGHAM SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Annual business meeting. Southern Club.

May 19—EASTERN NEW YORK SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Edison Club Hall, Schenectady.

May 19 — SAN FRANCISCO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

May 20 — AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, 370th meeting. Engineering Societies Building, New York City.

May 20— PHILADELPHIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Annual dinner, Hotel Adelphia Roof.

May 21 — ATLANTA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with ATLANTA SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

May 23-26 — AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Spring meeting. Congress Hotel, Chicago.

AMERICAN SOCIETY OF CIVIL ENGINEERS

At the regular meeting on April 6, Major-General John A. Lejeune, Commandant, U. S. Marine Corps, Washington, D. C., delivered an address, illustrated by moving picture diagrams on "The Battle of Meuse-Argonne."

Gen. Lejeune was commander-general of the Second Division of the American Expeditionary Forces in France, and participated in the St. Mihiel offensive, the battle of Mont Blanc Ridge (Champagne Sector, with the Fourth French Army), and the battle of Meuse-Argonne, in which his division co-operated with the Fifth French Army Corps. For conspicuous service in these battles, Gen. Lejeune was honored by the French government with the decorations of Commandeur, Legion d'Honneur, and Croix de Guerre with Palms, and was awarded the Distinguished Service Medal by Gen. Pershing and by the U. S. Navy. He participated in the occupation of Coblenz, Germany, and after his return to this country succeeded Gen. Barnett as Commandant of the U. S. Marine Corps.

FEDERAL HIGHWAY COUNCIL

Mr. S. M. Williams, chairman of the Federal Highway Council, announces the election of four new members to the executive committee of the council: Mr. W. J. L. Banham, general traffic manager, Otis Elevator Co.; Mr. David Beecroft, president, Society of Automotive Engineers and directing editor, Class Journal Co.; Colonel H. W. Alden, vice-president, Timken-Detroit Axle Co.; and Mr. S. P. Leeds, president, Atlantic City Chamber of Commerce.

Mr. Williams states that the selection of these men is in recognition of their interest and activities in the work of the Federal Highway Council, and the determination to place the work upon the broadest lines and under the direction of men of the widest experience.

AMERICAN ASSOCIATION OF ENGINEERS

The seventh annual convention of the American Association of Engineers will be held at the Hotel LaFayette, Buffalo, N. Y., on May 9, 10 and 11. The program for the first day includes the appointment of special committees, reports of officers and standing committees, and the report of judges of the election of officers which is now in progress. A discussion of chapter activities in practice by F. H. Newell, director of field forces of the association, will be followed by committee and council reports on employment, railroads, industries, federal, building and insurance trustees, salaries of engineers in public service and teaching service, education, services and fees of practicing engineers, legislative, chapter activities, municipal problems, water power and conservation, relation to foreign engineers, balloting, and organization. A smoker and entertainment will be held in the evening.

On May 10 the report of the committee on revision of constitution and by-laws will be received and discussed. In the afternoon a trip to Niagara Falls will be made.

The discussion and voting on amendments to the constitution and by-laws on the morning of May 11, a preferential voting to determine the next convention city, a report of the resolution committee and the convention will adjourn. In the evening will be held the annual dinner and installation of officers.

The election of national officers, which is now in progress and counting the votes of the 25,000 members will be accomplished at this election by having each man make his vote on a card ballot which will be punched and counted in a mechanical electrical tabulating machine.

The expenses of delegates to the annual convention of the association are paid by various chapters and it is certain that a representative gathering will be present.

NATIONAL HIGHWAY TRAFFIC ASSOCIATION

The National Highway Traffic Association will hold its 1921 convention at the Detroit Athletic Club, Madison and John R streets, Detroit, on Friday, April 29. Sessions will begin at 10:30 a. m., 2 p. m. and 8 p. m. The convention will be devoted to the presentation and discussion of progress or final reports of standing committees. The following list includes some of the important subjects pertaining to traffic regulations and efficient and economic highway transport which have been assigned to committees:

Interrelationship of Highway, Railway and Waterway Transport, Traffic Limit Lines on Roadway Surfaces; Design of Curves at Street Corners to Facilitate Traffic; Widths of Roadways and Sidewalks in Municipalities; Highway Transport Clearing Houses, Regulations Covering Speeds, Weights and Dimensions of Motor Trucks and Trailers, Relative Efficiency of Different Types of Car Stop Safety Zones and Their Relation to Parking and Ranking Regulations, Regulation of Overloading of Motor Trucks, Traffic Center Lines on Roadways, Relation of Impact Forces on Pavements to Resulting Impact Forces on Vehicles, Status of the Construction of Highway Curves and Recommended Practice to Increase Safety to Traffic, Highway Transport Franchises, Motor Bus Service for Consolidated Rural Schools.

AMERICAN ENGINEERING COUNCIL

A communication from J. Parke Channing, of New York, chairman of the American Engineering Council's

Committee on Public Affairs, also acting for the American Society of Civil Engineers, the American Association of Engineers and the American Institute of Consulting Engineers, has been placed before President Harding recommending that an engineer be placed on the Interstate Commerce Commission, with other recommendations for appointments to the three vacancies. A supplementary communication was also submitted to the President, naming six engineers with qualifications for this appointment.

The American Engineering Council's Committee on Procedure has appointed L. W. Wallace, executive secretary of the council, as its representative on the U. S. Board of Surveys and Maps. Members of the Advisory Council of the board have been urging the American Engineering Council to aid them in obtaining an adequate program involving a larger appropriation for topographic maps.

PERSONALS

Houser, W. H., has recently been elected city engineer of Blue Springs, Neb.

Reppert, Charles M., a consulting engineer of Pittsburgh, has been appointed chief engineer of the department of public works of that city.

Claflin, F. N., formerly construction engineer for the Superior Portland Cement Co., at Concrete, Wash., is now at Anchorage, Alaska, where he will have charge of the engineering work on the construction of a large coal washing plant for the government.

Place, Arthur H., is engineer in the Bureau of Government Research at Detroit, Mich.

Hatt, William K., professor of civil engineering of Purdue University, who was appointed chief of the division of engineering of the Indiana State Department of Conservation by the State Conservation Commission with the approval of Richard Lieber, director of the Conservation Department, took office on April 11. He will continue as a member of the Purdue University faculty during his term of office.

Shirley, Henry C., will accept the position of road and sanitary engineer of Baltimore county, with headquarters at Towson, Md.

Diehl, George C., has been re-appointed county engineer of Erie county, with headquarters at Buffalo, N. Y.

Moss, Earle B., has been appointed to the newly created office of appraiser in the Bureau of Assessment and Taxation, Niagara Falls, N. Y.

McLean, J. C., has been appointed county engineer of Woodbury county, Iowa.

Lukesh, Lieut.-Col. Gustave, has been confirmed as a member of the Mississippi River Commission.

White, Glenn S., has been appointed city engineer of Fort Morgan, Colo.

Hemstead, H. J., has been assigned to District 9, U. S. Bureau of Public Roads, with headquarters at Troy, N. Y., where he will be engaged in the inspection of post road projects.

Grant, Chief Robert H., has been re-appointed head of the fire department at Beverly, Mass.

Johnson, Herbert, of Kitchener, Ont., has been retained by the Village of Elmira to take charge of the construction of pavements.

Gatti, George, formerly good roads engineer for Bertile, Man., has been appointed assistant engineer, Trent Canal, Dept. of Railways and Canals, Peterboro, Ont.

Stewart, John H., town engineer of Renfrew, Ont., has been appointed town assessor, and will henceforth perform the duties of both offices.

Hawes, J. H., Irwin, Hydeman, McGimms, J. M., and Lundsen, Hugh A., have been appointed as district engineers, Ontario Dept. of Public Highways, to supervise the construction and maintenance of county and township roads, under the direction of R. C. Muir, chief engineer of county roads.

Cook, August D., president and founder of A. D. Cook, Inc., Lawrenceburg, Ind., manufacturers of deep well pumps and strainers, died on March 28, 1921.

Heaur, Albert R., was elected president and Peters, R. J., re-elected clerk of the village of River Rouge, Mich.

Dibble, Fred B., was elected president and Dysarz, Leonard, clerk of the village of Hamtramck, Mich., at a recent election.

Affleck, W. L., has commenced his duties as city engineer of Nelson, B. C.

Baird, John A., city engineer of Sarnia, Ont., has resigned.

Blue, Malcolm, of St. Thomas, has been appointed road superintendent of Dunwich township, Ont.

Brian, M. E., city engineer of Windsor, Ont., has been appointed road commissioner of the Windsor suburban area.

Meyers, A. J., formerly chief draughtsman for the Quebec Bridge Board of Engineers, has been elected mayor of Campbellford, Ont., and a member of the Water and Light Commission.

INDUSTRIAL NOTES

AMERICAN SPECIFICATION INSTITUTE

The American Specification Institute was permanently organized on March 18. The first board of governors consists of the following members: Chairman, Ralph W. Yardley; executive secretary, Gardner C. Coughlen; other members, C. L. Post, Frank A. Randall and A. T. North. Organization headquarters have been established in Chicago.

NEW ENGINEERING FIRMS

Johnson & Benham, Inc., consulting engineers, of New York and Kansas City, Mo., announce the reorganization of the business. All contracts and business of the New York office have been taken over by George A. Johnson Company, Inc., the members thereof being George A. Johnson, Harold C. Stevens, Nelson B. Wolfe, Charles R. Wyckoff and Harry B. Joyce. The main offices of the corporation are at 150 Nassau street, New York City. All contracts and business of the Kansas City office have been taken over by Benham & Mullergren, a partnership consisting of Webster L. Benham and Arthur L. Mullergren, with offices on the eighth floor, Firestone building, Kansas City, Mo.

The Mid-West Engineering Co., Coffeyville, Kan., has been organized by G. A. Barcroft, assistant construction engineer of the Sinclair Refining Co., and other engineers of experience, and will engage in general engineering practice, including buildings, power development, water dams and reservoirs, surveys, maps, estimates, designs and investigations.

E. F. Pegg, who has been connected with manufacturers of contractors' equipment in Cleveland and vicinity for a number of years, has opened an office in Cleveland for the purpose of handling contractors' equipment.

Morrison & Risman Co., of Buffalo, N. Y., jobbers in new and relaying rails and accessories, has opened an office in Philadelphia, Pa., with R. B. Morrison as district manager.

The Stearns Conveyor Co., Cleveland, Ohio, has been organized by Earl D. Stearns, formerly of the H. K. Ferguson Co., Cleveland, Ohio, and will handle elevating, conveying, screening, transmission machinery and accessories.

Greene, H. S., has been elected vice-president in charge of sales for the Barber-Greene Company, Aurora, Ill.

Puff, C. F., Jr., assistant engineer, Bureau of Highways, Philadelphia, has been appointed secretary and general manager of the Associated Pennsylvania Highway Contractors, office 200 North 3d street, Harrisburg, Pa.

The Meriwether Pressure Pipe Co. has been incorporated with offices at Louisville, Ky., to manufacture reinforced concrete water pipes.

Drifting Sand Filters, Ltd., with headquarters at Toronto, Ont., has been incorporated at Ottawa, Ont., to take over the Canadian patent rights of the John VerMehr Engineering Co., and to promote drifting-sand filters.

The Austin Machinery Corp. of Louisiana, Inc., is sole distributor for Louisiana, Arkansas, Mississippi and Tennessee for the products of the Austin Machinery Corp.

H. C. Nutting, manager of the Pittsburgh Testing Laboratory, Cincinnati Ohio, for the past six years, has recently organized a new company under the name of H. C. Nutting Co., at Hunt and Broadway, Cincinnati. Mr. Nutting is highway engineer of the Cincinnati Automobile Club and will specialize in highway inspection.

The Brown Hoisting Machinery Co., of Cleveland, Ohio, announces the opening of a southern office, to be located at 530 Whitney-Central building, New Orleans. The state of Texas, Louisiana, Mississippi, Alabama, Georgia and Florida will be covered from this office.

Charles H. White, manager of the new office, has been with the Brownhoist company for a number of years, and is an experienced sales engineer on all types of Brownhoist products. Among these are locomotive cranes, buckets, electric hoists, trolleys and a wide range of cranes and hoists.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

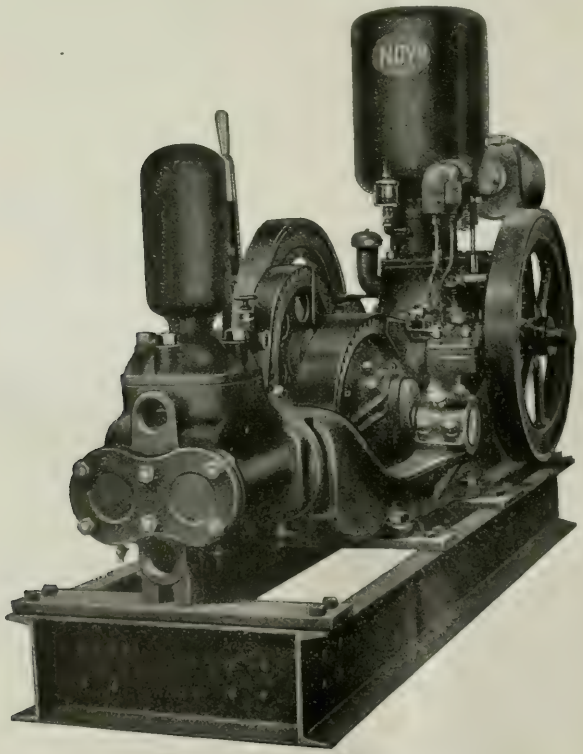
NOVO HIGH PRESSURE PUMPING OUTFIT

The high pressure pumping outfit manufactured by the Novo Engine Co. claims excessive size, durability and efficiency for high pressure work. The type U is made in 5 sizes, 1½ to 6 h. p., with capacities of 16 to 36 gallons per minute pump displacement, with maximum working pressures of 100 to 200 pounds, and weights of 225 to 1,240 pounds.

Type U, with clutch equipment, is made in 5 sizes of 8 to 10 h. p., with capacity of 60 to 100 gallons per minute pump displacement made with maximum pressure of 100 to 135 pounds and weights of 2,500 to 2,800 pounds. One size of each kind of the type U machines is especially adapted for furnishing water supplies for road construction.

The new type W double acting duplex pumping outfit is suitable for all around pumping purposes and especially adapted to furnish water suplies for road construction. It is furnished in 6, 8 and 10 h. p. sizes with capacities from 20 to 50 gallons per minute under pressures of 150 to 300 pounds. The type W consists of a double acting duplex pump and a standard Novo engine mounted together on a steel channel base, making rigid unit with a contracting band friction clutch for disconnecting the pump when starting the engine. When the crank is set at 90 degrees the pressure strokes overlap so that a continuous stream of water is supplied, thus reducing the water hammer in long pipe lines. The unit is made in 5 sizes of from 6 to 10 h. p., with capacities of 30 to 45 gallons, pump displacement per minute and maximum pressure of 150 to 300 pounds and weighs 3,750 to 5,400 pounds. The 8 h. p. unit has 2-inch suction and discharge pipes, capacity of 45 gallons at 200 pounds pressure, and is especially recommended for road construction work.

The Novo high pressure triplex pumping outfits are self-contained units with a three-throw crank shaft giving continuous and uniform action and an easy flow through the delivery pipe. It is made in 7 sizes of 4 to 15 h. p. with capacities of 80 to 125 gallons per minute, pump displacement, under pressures of 150 to 250 pounds and weighs 1,225 to 5,300 pounds. The 8 h. p. unit with 2-inch suction and discharge pipes and a capacity of 45 gallons at 150 pounds pressure, is recommended for road construction.



NOVO HIGH PRESSURE PUMP

METER

The recording rate-of-flow meter manufactured and sold by the Pittsburgh Filter & Engineering Company gives a direct-reading seven-day chart, and furnishes records of pumping and consumption.

The device consists substantially of a combination of a special Venturi meter with a controlling device operated by the different pressures of the approach and throat of the Venturi meter and equipped with a pilot valve regulating the proportional flow diverted to the Venturi tube.

RECORDING METER

This controlled proportional flow is delivered to the indicating, integrating and recording rate-of-flow meter, which gives a weekly record of the rate of flow and also registers the total flow automatically on a chart drum driven by clockwork and provided with a pen raised and lowered by the integrating meter. The operation of the mechanism is described in the circular, which also gives examples of seven-day direct-reading chart.

NEW PAVEMENTS AT HALF THE COST

Under this title the Barber Asphalt Paving Company has issued an illustrated pamphlet describing the method and operations of resurfacing highways with a macadam base or with a concrete foundation. It also describes the methods of resurfacing a brick pavement with or without removing the bricks, for resurfacing a granite block pavement with concrete base without removing the blocks, and for resurfacing a wood block pavement after removing the blocks and the sand cushion below them.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Municipal Journal and Engineer, Inc

Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.

Entered as Second Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879

Vol. 50 APRIL 30, 1921 No. 18

Refuse Disposal in Passaic

By Colin R. Wise*

Dumping of all refuse is to be succeeded by burning in an incinerator plant containing two 42-ton units, with forced draft, ash removal cars and complete equipment. Steam to be created and used for heating hospital building.

Passaic, N. J., a city with about 67,000 population, is about to put a new refuse incinerator into service. Up to this time it has disposed of all of its refuse by dumping, some of it in abandoned quarries or low lots, but the greater part on low land along the river and in an old channel of the river between the city and the channel now followed by the river. The garbage has been mixed by the householders with such refuse as could readily be placed in the garbage pails, other rubbish, such as mattresses, clothing, tree trimmings, etc., being removed if done up in bundles by the householder. The mixed garbage and rubbish was ordinarily dumped to a depth of about 5 feet on the face of a constantly advancing fill and then covered with ashes or earth.

Rats and flies were naturally abundant in and near these fills, but otherwise there was little nuisance created except that due to fire. On several occasions combustible matter in the refuse piles has caught fire and such fires it has been found almost impossible to extinguish. One pile burned continuously for more than two years,

*City engineer, Passaic, N. J.

GENERAL VIEW OF INCINERATOR BUILDING
Approach to the charging floor is along the top of the quarry, at the right.

and the only result of efforts of the fire department to drown it out was to cause the burning garbage to give off fumes and odors that were seriously objectionable.

For collecting the rubbish, the city used ordinary dump wagons, both bottom dump and end dump. A few months ago, however, the city purchased six Lee trailers and automobile trucks for hauling the same and has been using these for collecting refuse while waiting for the completion of an incinerator which has been under construction for several months.

Until the past few weeks the garbage and ashes were not separated. During the month of April, 1912—nine years ago—the ashes and garbage were weighed and their combined weight found to be 956¾ pounds per cubic yard. There had been no weighing since then until the early part of the current month, when the new trailers, with garbage only, were weighed upon the city's scales at the Municipal Building and the weights were as follows: Average weight of trailers, 4,987 lbs.; of garbage and refuse, 427 lbs. per cubic yard. The garbage and refuse collected so far during the month of April indicate that there is now approximately 39.5 tons of matter to be cared for by the incinerator. Of course, as warm weather comes, the volume will greatly increase.

The city slopes up irregularly, but in most places quite rapidly, from the river to several summits about 100 feet above the river. Several quarries have been opened in these hills and one of these has been chosen as the site of the incinerator, which is set in the bottom of the quarry against the vertical face, the top of the quarry being on a level with the dumping or hopper floor of the plant, thus doing away with the necessity for a ramp.

Bids were received on March 8, 1920, for an incinerator of two units, each with a capacity of burning 42½ tons of refuse in 24 hours, the refuse to consist of "material collected by the city carts of Passaic, N. J., including such dry combustible refuse matter as wooden and paper boxes, cut grass, leaves and branches of trees . . . of a mixture made up approximately as follows: 70 per cent of garbage by weight, 30 per cent of rubbish or refuse by weight, and dead animals." The contract was awarded to the Decarie Incinerator Company, which has just completed the plant, having been hindered somewhat by delays in transportation. The price bid was $157,800, this covering the complete installation erected, including a concrete and brick building, a stack 125 feet high, approaches to the building, and the incinerating equipment complete, with provisions for handling ashes and clinkers inside the building.

The builder guaranteed that the amount of fuel required for operating the incinerator should not exceed 50 pounds per ton of refuse consumed, and that not more than 7 men—1 superintendent, 3 firemen and 3 laborers—would be required to operate the plant at its full rated capacity. It also guaranteed that the plant under normal operation will cause no nuisance from the escape of obnoxious odors or gases from either the building or the stack. Also that the refuse will be incinerated to a mineral ash free from organic material.

DESCRIPTION OF THE INCINERATOR

The building contains three floors, one for removing clinkers from the ash pits, another for stoking and otherwise operating the incinerator, and the third floor, above the incinerator, on which the rubbish wagons are driven directly and where they dump their loads into the incinerators, through two hoppers.

The building is 67 feet 8 inches by 40 feet 4 inches outside dimensions and about 45 feet high. Concrete stairs connect the several floors. The floors are of concrete and are sloped to drains that lead to a sewer. Leading to the upper or charging floor are two bridges connecting it with the top of the quarry face, each leading to a doorway 10 feet 6 inches high by 13 feet wide and closed by a steel rolling door. In one corner of this floor are two chutes, one leading to a coal bin and the other to a wood bin. Very little, if any, coal will be required, but broken boxes and other material arriving with the refuse that are especially good for kindling will be dumped into the wood bin for use in starting up the furnace.

In the floor are two hopper openings, one over the center of each of the incinerators (which are exact duplicates), the top of the opening being 6 feet 2 inches by 5 feet 2 inches. Below each opening is a storage hopper capable of holding about 3 cubic yards. The bottom of the hopper is formed by two swinging doors which are held in a horizontal position by a counter-weight, but which can be lowered to deposit all or part of the contents into the incinerator. As soon as refuse has been dumped into a hopper, a cover is placed over the hopper opening so that, when the hopper is being emptied of its contents, air cannot have access to the incinerator to cut down the draft through the grate.

On the floor below, known as the furnace floor, are the incinerators, fans, pump and all the other apparatus except the clean-out doors and the track for carrying the cinder cars by which the cinders are removed from the building.

Each incinerator is 6 feet 8 inches by 10 feet 8 inches outside dimensions. It is composed of a double wall of boiler plate, the two walls being 3¼ inches apart, which space is filled with water when the incinerator is in operation. Inside of this double wall is a large basket grate formed of 2-inch water tubes spaced 12 inches centers, connected near the top of the furnace to the water-jacketed wall and at their lower ends to a header 8 inches in diameter running through the center of the furnace. The water tubes forming this grate are about 4 inches inside of the furnace shell so that the refuse dumped into the basket grate can be dried and partly burned by flames and hot gases rising between this grate and the shell, as well as by the heat from the fire beneath. About two feet below the bottom of this drying water-tube grate are cast-iron dumping grates. On these grates the fires are started with kindling material in beginning the firing of a furnace, and on to these grates fall the dried and

partly burned refuse matters from the basket grate above, and incineration is completed there.

From the dumping grates the ashes and cinders fall into a large ash pit immediately beneath, the floor of which slopes to a clean-out door 30 by 36 inches, the bottom of which is 4 feet above the elevation of a track, the nearer rail of which is 21 inches from the door. Dump cars are run on this track and spotted in front of the clean-out openings and receive the cinders and ashes and conduct them outside the building, where they will be dumped in the bottom of the old quarry.

While the incinerator is in operation, water circulates continually through the water-jacketed shell of the furnace, the header and the pipes forming the basket or drying grate, and the steam created collects in the upper part of the furnace, where the inner and outer shells of the top are about 2 feet apart, thus providing a steam dome. This steam will be used for operating the blowers and pump; also for heating a hospital building located about 500 feet from the incinerator plant, and for furnishing hot water in the plant itself, and in the hospital referred to.

The chimney is built of radial brick, has an inside diameter of 5 feet 6 inches at the top and is 125 feet high. In order to insure sufficiently high temperature to destroy gases and odors and sufficient draft through the burning refuse, two fans are provided, a forced draft fan with a capacity of forcing 41.3 cubic feet of air per minute at 100 degrees Fahrenheit through the pre-heater and into the ash pit below the shaking grates, when operated at 565 r. p. m. against a static head of 3 inches. Also an induced draft fan capable of handling approximately 22,500 cubic feet per minute of gases against a static pressure of 1¾ inches when operating at 467 r. p. m. Each fan is operated by its own steam engine. The gases and hot air from the furnace pass into a combustion chamber, through a fire-brick checker wall 13½ inches thick, and then through a pre-heater and thence to the stack. The flue gases pass through the tubes of the pre-heater, while air from the forced draft fan passes around these tubes and is heated, a temperature of at least 400 degrees Fahrenheit being guaranteed for the forced draft air. From the pre-heater this air passes through a large flue to the ash pit, which is completely enclosed except for the openings in the dumping grates above, and this heated air is thus forced through the burning refuse. By-passes around the pre-heater are furnished which can be used when the fires are started and at such other times as may be desired. All ducts are of steel plate lined with fire-brick and are provided with dust pits and clean-out doors for removing the dust that may collect in them from the flue gases.

The combustion chambers and pre-heater occupy much more space than does the incinerator, the latter being 6 feet 8 by 10 feet 8, while the combustion chambers and pre-heater combined occupy a space about 14 by 17.

In order to conserve the heat in the water used in the furnace, the return water from the steam pipes is drawn into a 3 feet by 5 feet steel tank, in which is a flow-control valve for admitting city water to make up any losses. From this tank the hot water is drawn by a 5 [illegible] by 3 [illegible] by 3-inch duplex steam pump. An injector also is furnished for filling the boilers. For preventing loss of heat and reducing the temperature in the building, the furnaces are covered down to the stoking doors with 2 inches of magnesia blocks covered with a half-inch coating of cement.

Hot and cold water and steam connections are provided on each floor for cleaning and sterilizing purposes. Electric lights are provided for lighting the building and the interior walls are painted white down to a point a few feet above the floor, thus aiding in giving abundance of light inside the building. A room for the men, containing clothes lockers, toilet, etc., and another to be used as an office by the superintendent, both steam-heated and lighted, are provided at the ends of the main floor.

Studies are now being made for routing the trailers for collecting the refuse. This will be divided into two classes—ashes, and mixed garbage and combustible rubbish. The former will not be brought to the incinerator, but will be hauled to the nearest dumping place. It is probable that a truck and two trailers will be used for ashes, and the other four trailers for collecting garbage. It is intended to use a tractor driver and one man with each trailer.

(*Continued on page 384*)

MOVING INCINERATOR INTO BUILDING

Operating Data of Fine Screen and Imhoff Tanks*

By John R. Downes†

Although there are many Imhoff installations in the country (there are thirty-four in New Jersey alone) few of them are operated with the intelligent care that has been given to this plant by Mr. Downes, and his opinions, based on years of personal supervision, should be of exceptional value to superintendents and operators of such plants.

Four years of operation of the Plainfield, North Plainfield and Dunellen, N. J., joint sewage disposal plant§ have made available some data on quantities of solids removed, both by the Wurl screen and the Imhoff tanks, which data I propose to put before you in very brief form, so that it will be available for reference in connection with future designs. Past discussions of the subject have supplied an abundance of opinion and theory. I shall therefore confine myself to a rather bald statement of observed quantities.

The plant was designed for 40,000 people, and is of the separate domestic type. The sludge separating portion of the plant originally consisted of six Imhoff tanks, each with a total flow length of 64 feet and a total width of 25 feet. Each tank has four longitudinal settling compartments with effective width of 5 feet each. Two gas vents, each 22 inches wide in the clear, extend the entire length of the tank. The walls extend perpendicularly to 5 feet 6 inches below the flow line. The slopes, about 1 on 1, extend to the slot 11 feet below the flow line.

The tanks were put into operation at the end of November, 1916, and operating experiences during the ensuing year indicated the necessity of removing the coarser solids, paper, fiber, hair and fecal matter from the sewage before it was admitted to the tanks; such solids not being amenable to treatment in the tanks. For the purpose of removing these coarse solids a Wurl screen was added to the sludge separating equipment and was put into operation in September, 1918.

The Wurl screen is essentially a brass disk, 10 feet in diameter, revolving on a shaft inclined 15 degrees. The disk is perforated with some 12,000 slots, each 1/16 by 2 inches, and is submerged to about half its depth in the flowing sewage. The solids, which are caught on the surface of the screen, are swept into a trough by the revolving brushes which continually scour the unsubmerged portion of the disk. A one-horse power electric motor which can be adjusted to run at speeds from 600 to 1,800 R. P. M. operates the screen mechanism.

The appended table gives information concerning the suspended solids in P. P. M., as determined by the Gooch crucible method, the number of cubic yards of digested sludge removed from the tanks (measured by shutting off the tank during drawing of sludge and measuring the depression of the water level), the number of cubic yards of air-dried sludge removed from the drying beds (cart measurement), the sewage flow in million gallons and the number of house connections at the end of each month.

Two of the municipalities contributing to the plant were installing sewers for the first time, and the third took in large sections of sewers, so that the increase in number of connections during the first year was very rapid. In order to make the complete sludge data of the four years available for estimation of per capita and per connection quantities, the number of connections at the end of each month have been added together and multiplied by 30 to get the number of connections-days contributing the observed quantity of sludge; five times this figure is considered the number of person-days; this figure checks up well with the known population.

Screenings were measured in a wagon, most of the free water having drained away before measurement was made. The dry solids=11 per cent.

Operating Data on Screen and Tank

YEAR	Suspended Solids P. P. M.		Sludge from		Screenings		Flow		House Connections
	Screen Effluent	Imhoff Effluent	Tanks C. Y.	Beds C. Y.	Total Cu. Ft.	Daily Cu. Ft.	Total M. G.	Daily M. G.	
1917	(*)148	57	1,608	586	....	..	959	3.0	5,853
1918	(*)140	49	3,530	1,090	....	..	1,253	3.4	6,398
1919	(*)142	38	4,069	877	18,250	50	1,301	3.6	6,804
1920									
Dec.	176	71	....	12	1,220	47	110	3.6	6,905
Jan.	135	70	....	..	1,361	45	109	3.5	6,909
Feb.	123	69	....	28	1,273	44	100	3.5	6,912
Mch.	116	67	415	..	1,393	46	133	4.3	6,921
Apr.	157	66	230	97	1,383	46	113	3.8	6,943
May	148	80	588	61	1,364	44	105	3.4	6,969
June	181	57	631	302	1,302	43	93	3.3	6,993
July	175	57	475	92	1,426	46	96	3.5	7,003
Aug.	152	48	523	129	1,420	46	97	3.4	7,036
Sept.	174	65	575	251	1,282	41	96	3.2	7,076
Oct.	193	66	364	109	1,567	52	97	3.1	7,078
Nov.	208	82	346	69	1,359	45	95	3.1	7,111
1920									
Ave.	161	66	3,807	1,140	16,351	..	12,430	....	..

Sludge from tanks = 6 to 46% solids.
(*) Raw in 1917, 1918, 1919. Higher results in 1920 due to mixing and comminuting effect of screen on the solids. Samples during 1919 were taken before sewage passed the screen.
Bulk of settleable solids = 7% on dry basis and 10% of total settled.
Screenings indicated in above table amount to 0015 cu. ft. per person day.
Digested sludge indicated in above table amounts to 0085 cu. ft. per person day.

At the end of the fourth year of operation a sludge survey of the digestion compartments in-

*Paper read at the meeting of the New Jersey Sewerage Works Association held at the State House, February 18, 1921.
†Superintendent, joint sewage disposal for Plainfield, North Plainfield and Dunellen, N. J.
§This plant was described in our issue for November 29, 1919.

dicated that there remained at that time 750 cubic yards of sludge. In three of the tanks the sludge was at the bottom of the hoppers, and in the other three it was almost entirely floating at the surface of the gas vents (this in spite of constant effort to beat it down).

In addition to the above solids there has been removed from the gas vents a quantity of partly digested sludge estimated at 1,000 cubic yards. This was removed by pumping and by wheelbarrows and ranged in consistency from a watery 96 per cent sludge to a viscous 88 per cent mass, containing much hair and fiber.

The sludge digestion portion of the plant consists of ten sludge hoppers to each tank—these are in two rows of five each—directly beneath the gas vents. The depth between the slot communicating with the settling compartment and the top of the hoppers is 6 feet, providing a total settled sludge capacity of 57,000 cubic feet.

With any operating program which we have been able to develop, there accumulates in time a mass of floating sludge of so slight a specific gravity that it will never settle. I do not refer to the thick, viscous sludge appearing at the top of the gas vents and which may be wheeled off in wheelbarrows, but to a sludge of 95 per cent water content and thoroughly digested. This sludge, floating throughout the entire depth of the digestion compartments and gas vents, is naturally carried back via the slots to the settling compartment by various currents. The result is a black film on the surface of the settling compartment and a very poor looking effluent with an avidity for oxygen which is a serious drain on the sprinkling filter.

It now appears that it will be necessary to pump out the upper portions of the digestion compartments at least once a year, in order to dispose of this digested but unsettleable sludge.

Practically every known method has been tried to prevent foaming in the gas chambers of the tanks. These methods included: Seeding with foreign sludge; application of lime to the sewage in the gas vents; application of water under pressure to scum formation; application of steam; breaking of scum with paddles; covering gas vents so as to retard the drying of the scum; and the reversal of the direction of flow in the tanks. It is the writer's opinion that in order to prevent the foaming of the scum over the top of the tanks, it is necessary for him to operate his tanks in rotation and to pump out the upper portions of the digestion compartments of the tanks at least once a year.

With regard to sludge drying, we find that with 35,000 connected population, we have approximately 4,000 cubic yards of sludge to be removed from the tanks each year.

Our experience shows that it is not economical to put over 9 inches of wet sludge on a bed, since this quantity will dry in a week or ten days of good weather, while any greater quantity will require a time measured in weeks.

It is surprising to find that, in spite of the fact that a coat of sludge 9 inches thick will become spadable in a week or ten days of good drying weather, under actual climatic conditions, we have averaged only a scant 6 dryings per year. The figures for three years are 5.8, 6.0 and 5.8 dryings per bed a year.

Therefore, to dry 4,000 c. y.=108 cubic feet of sludge per year, requires 108,000÷.75=144,000 square feet of drying surface per year, and 144,000 ÷6=24,000 square feet drying area required to take care of 35,000 people under local weather conditions. This amounts to .686 square feet per person.

Operating costs outside of supervision and organization charges are shown in some detail for 1920. It would hardly be worth while to go into operating costs for the other three years on account of the sliding scale value of the dollar, but the proportional distribution will be very nearly the same as for 1920.

It is interesting to note that, outside of interest charges, the comparative costs as between screening and removing the objectionable solids from the tanks by hand are just about equal; that is to say, the time now spent by a watchman on the screen and the cost of power about equal the cost of labor in removing the coarse solids. The plant, however, is much more workable and the nature of the labor much less objectionable when the solids are removed before reaching the tanks.

Outside of the Imhoff tanks and the Wurl screen, which, in view of the above statement, must be considered as a charge against the tanks, one man could do all that is necessary about the plant. To this other work we will suppose the highest paid laborer to be assigned and charge all ordinary labor to care of screen and tanks and to sludge removal.

COST OF OPERATION—1920

	Total	Chargeable to Screen, Tanks and Sludge Removal
Labor	$6,437.66	$4,637.66
Heat, light, power, etc.	1,131.39	240.00
Supplies, tools	1,017.59	1,017.59
Machine repair, tractor, spreaders, etc.	247.05	247.05
Screen, motor repair	186.28	186.28
Gasoline, oil, etc.	370.80	370.80
	$9,390.77	$6,699.38

Expressed in man hours, the labor required to operate the plant is:

For general attention to plant	2450	man hours	per	year:	
For night watch on screen	5630	"	"	"	"
Care of tanks	5820	"	"	"	"
Drawing and hauling sludge	1242	"	"	"	"
Or General Plant	8	hours	week	days:	
Watch on screen at night	16	"	"	"	"
				and	Sundays
Care of tanks	17	"	"	"	"
Drawing and hauling sludge	4	"	"	"	"

The screen has run practically continuously for two years. The first set of screen cleaning brushes lasted exactly two years before requiring replacement. The speed control apparatus on the motor is the only thing that has given any trouble—$151.01 has been expended to date on this item. Two broken brush flanges, cost for replacement, and a duplicate of each for stock, $38. The current consumption is from 9 to 12 K. W. H. per day.

The maximum (working) loss of head on the screen is 13 inches, and the capacity of the screen with 13 inches loss of head and full screen speed (about 1 R. P. M.) is at the rate of 4,750,000 gallons per day.

Drag-Line Cofferdams

River excavations for piers of a 7-span concrete arch bridge at Dayton, Ohio, made in earth cofferdams constructed by an 85-ton drag-line excavator.

The new Black Street bridge across the Miami river at Dayton, Ohio, has seven 93-foot concrete arch spans supported on two abutments and six intermediate piers, the latter having concrete footings 12 to 20 feet below the river bottom supported on wooden pile foundations. Piers 2 and 3 are adjacent to the deep-water channel and the others are either in shallow water or in the river bottom that is submerged in high water. They have all been built in excavations enclosed by earth embankment cofferdams without core walls or sheet piling. The excavations were made by a submerged scraper bucket depositing the spoil in the levees that form the cofferdam embankments.

The river bottom consists of cemented sand and gravel with occasional clay strata through which, when encountered, the excavation was carried.

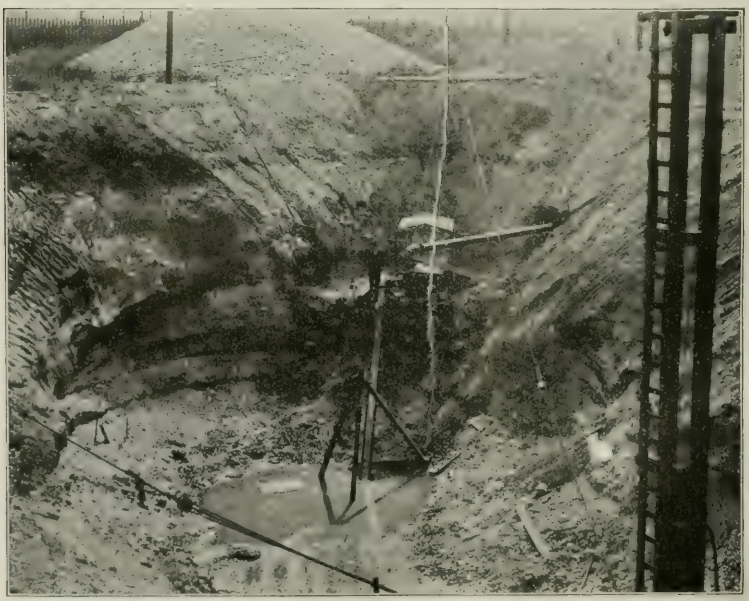
The operations were commenced by the installation on a levee, built in the river bed, of a class 14 Bucyrus drag-line excavator with 70-foot boom and 1½-yard bucket. It was mounted on caterpillar tractor, weighed 85 tons and was purchased second hand for $18,000. The excavation was carried down to a depth of about 20 feet below the original surface of the river bottom and the machine advanced without difficulty on the levee that it constructed to form the cofferdam extending around four sides of the pier.

After completing the cofferdam for pier 3, which was the first one constructed, there were installed in it one 4-inch, one 6-inch and two 8-inch centrifugal pumps driven with 30, 40 and 50 h. p. electric motors. The 4-inch pump and one 8-inch pump were operated continuously, the other two intermittantly, to handle a maximum of 4,000,000 gallons of water daily.

Ordinary practice was deviated from by installing the pumps with a normal lift of 20 feet, increasing sometimes to 23 feet, so as to avoid the possibility of flooding the electric motors by water rising in the excavation on the frequent occasions when the electric power was cut off.

The construction of the cofferdam by this method was so successful that it was immediately adopted for pier 4 on one side and then for pier 2 on the other side of pier 3, all three of which were eventually enclosed in one enlarged cofferdam. The sediment brought down by a flood in the river seeped into the levees and silted them so rapidly that the inflow of water into them did not increase and was little larger for the three piers than for the first pier alone. After the completion of these three piers the drag-line proceeded toward the end of the bridge and successively built the cofferdams for piers 5 and 6 that were eventually connected in one. These cofferdams were unwatered by one 18-inch pump with 18-inch suction operated by a 75 h. p. motor. The caterpillar traction of the excavating machine proved very satisfactory for its convenient handling on the tops of the levees and to enable it to be quickly removed in case of flood.

A 9-foot flood causing a swift current through the narrow passage between cofferdams 3 and 4 scoured away 10 feet on the upper part of the levee on one side, but as it did not deposit the material inside the cofferdam, little damage was done and after the levees had been restored by the drag-line machine the excavation was cleared in about 2 hours of hand work and the total delay caused was only about 2 weeks.



ELECTRIC CENTRIFUGAL PUMP UNWATERING ABUTMENT EXCAVATION.
Tripod in sump supports tackle for raising suction to permit removal of obstructions.
Horizontal discharge pipe buried in cofferdam levee.

This method of building the cofferdams was considered desirable on account of the rapid handling of the bucket without interference from inside bracing; the greater efficiency of the drag-line bucket as compared with a clam-shell bucket; the elimination of pumping costs during excavation; elimination of sheet piling and bracing costs, and because of the availability of the drag-line machine for service as a locomotive crane for pile driving operations subsequent to the excavation.

Computing Parabolic Curves for Street Grades

By Walter W. Kane*

Time-saving methods of solving problems arising in computing curves for connecting different grades at their intersections.

The writer has devised these two methods as time savers, especially where a number of trial curves have to be taken to give the best results, and agree with improvements on the curve.

I. The tangent rates being given and the tangent points fixed, to calculate the elevations on the intervening stations of the curve; stations equidistant: Divide the difference in the rates (by taking their sum where there is a summit or a pocket and their difference where they are both ascending or descending) by twice the number of stations. Call this result the factor. Add or subtract† this factor from one of the tangent rates so as to make it approach the other tangent rate. This will give the grade rate of the first section on the curve. Then add or subtract double the factor from this rate and proceed until the last station or the tangent point. Adding or subtracting the factor will then give the second tangent rate as a check. Then multiply the rates so obtained by the distances, add or subtract these results, and work from one tangent point to the other.

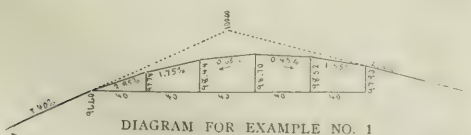


DIAGRAM FOR EXAMPLE NO. 1

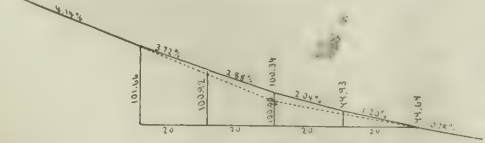


DIAGRAM FOR EXAMPLE NO. 2

*Principal Assistant Engineer, Department of Streets, Newark, N. J.

†By calling rising rates plus and descending rates minus, the factor would always be subtracted and the "add or subtract" ambiguity would be avoided, and the signs used in the calculation of elevations would be obtained automatically.—Editor.

Example 1, with a summit.

Distance between tangents, 200 ft.; number of stations, 5.

$$\frac{\text{Difference in rates}}{\text{Twice number of stations}} = \frac{5.50}{10} = 0.55 \text{ factor}$$

(1)	3.40 tangent rate
Minus	0.55 factor
	2.85 rate ascending
Minus	1.10 double factor
	1.75 rate ascending
Minus	1.10
	0.65 rate ascending
Minus and plus	1.10
	0.45 rate descending
Plus	1.10
	1.55 rate descending
Plus	0.55
	2.10 checks with tangent grade.
(2)	96.60 tangent grade
+ 2.85% × 40	1.14
	97.74
+ 1.75% × 40	0.70
	98.44
+ 0.65% × 40	0.26
	98.70
− 0.45% × 40 −	0.18
	98.52
− 1.55% × 40 −	0.62
	97.90 checks with tangent grade.

This method can also be applied where there is a pocket.

Example 2, grades both ascending or descending.

Distance between tangents, 80 ft.; number of stations, 4.

$$\frac{\text{Difference in rates}}{\text{Twice number of stations}} = \frac{3.36}{8} = 0.42 \text{ factor}$$

(1)	0.78 tangent rate
	0.42 factor
	1.20 rate
	0.84
	2.04 rate
	0.84
	2.88 rate
	0.84
	3.72 rate
	0.42
	4.14 checks with tangent rate.
(2)	99.69 tangent grade
+ 1.20% × 20	0.24
	99.93
+ 2.04% × 20	0.41
	100.34
+ 2.88% × 20	0.58
	100.92
+ 3.72% × 20	0.74
	101.66 checks with tangent grade.

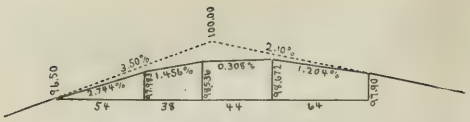


DIAGRAM FOR CASE II.

II. Where the stations are not equidistant: Divide the difference in grades as before by the distance to the first station plus the sum of the first and second, second and third, etc., continuing until the last section is reached, and add the last. Multiply this quotient by the several sums used, and proceed as before.

First station	54
First and second	92
Second and third	82
Third and fourth	108
Last	64
	400

[illegible] 6)

[illegible]00 = .14 factor

	3.50	tangent rate
— .14 × 54 =	0.756	
	2.744	grade ascending
— .14 × 92 =	1.288	
	1.456	grade ascending
— .14 × 82 =	1.148	
	0.308	grade ascending
— .14 × 108 =	1.512	
=	1.204	grade descending
— .14 × 64 =	0.896	
=	2.100	checks with tangent rate.

(2)	96.50	tangent grade
54 × 2.744% =	1.482	
	97.982	
38 × 1.456% =	0.553	
	98.535	
44 × 0.308% =	0.136	
	98.671	
64 × — 1.204% =	0.771	
	97.900	checks with tangent grade

III. Having selected a parabolic grade curve having a summit or pocket, to calculate the position and height of the pocket or summit: Divide the smaller tangent rate by the sum of the tangent rates: multiply by the total length of the curve. This will give the distance from the higher tangent point to the summit. Multiply this distance by one-half the smaller tangent rate, add this to the high tangent elevation; the result is the elevation of the summit.

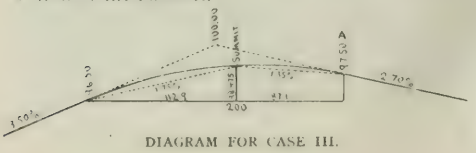


DIAGRAM FOR CASE III.

Smaller rate	2.70	
	——— × 200 = 87.1,	distance from A to summit
Sum of rates	6.20	
87.1 × 1.35	1.175	
	97.30	
Height of summit	98.475	

Check:	112.9 × 1.75 =	1.975
		96.50
		98.475

This method can be applied to a pocket also.

It will be found that the results obtained correspond exactly with those obtained by parabolic formulas. The methods here employed have the merit of being self-checking.

Concrete in Sea Water

In an experimental investigation conducted by the Aberthaw Construction Company, of Boston, twenty-four large concrete specimens were exposed for 12 years to the alternate action of sea water, atmosphere and frost to determine whether it is possible to make concrete that will completely resist the above conditions.

There were made in the Boston Navy Yard twenty-four 16 x 16-inch specimens 16 feet long without other reinforcement than a ⅝-inch full length twisted steel lifting rod. In the top of each specimen there was bored a 2½-inch hole 8 feet long that was closed with a screwed cap.

The specimens were made of concrete proportioned 1:1:2, 1:2:4 and 1:3:6, with eight different brands of Portland cement, trap rock broken to pass a 1¼-inch ring and having the dust screened out, and fine sharp sand with about 4.6 per cent moisture.

The concrete was machine mixed dry, plastic, and very wet, in different specimens, was poured in horizontal forms and after five weeks' seasoning was suspended under a pier in such manner that the lower ends of the specimens were always submerged and the upper ends were always above water level. After several months the holes in seven of the specimens were found dry and the remainder contained from 16 to 65 inches of water.

From time to time the specimens were inspected, photographs made, and their conditions recorded. At the end of 12 years five of the specimens "showed little or no effect from their immersion." Of the remainder, one specimen was entirely destroyed and disappeared in the center part, another was half destroyed and disappeared and the remainder were more or less injured, decayed, disintegrated or reduced in size. The test and results are carefully described in a handsome report published by the Aberthaw Company and illustrated with two photographs of each specimen, one taken about 5 years after the test was commenced and one taken after its termination.

The report also includes tests of the neat cement and of the cement mixed with hydrated lime and with pulverized clay and analyses and tests of the stone and sand.

PUBLIC WORKS

Published Weekly
by
Municipal Journal and Engineer, Inc
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba . $3.00 per year
All other countries .....$4.00 per year

Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses

Telephone (New York): Bryant 9591
Western office Monadnock Block Chicago

A. PRESCOTT FOLWELL Editor
FRANK W. SKINNER, Associate Editor

CONTENTS

REFUSE DISPOSAL IN PASSAIC—Illustrated—By Colin R. Wise 367

OPERATING DATA OF FINE SCREEN AND IMHOFF TANKS—By John R. Downes 370

DRAG-LINE COFFERDAMS—Illustrated 372

COMPUTING PARABOLIC CURVES FOR STREET GRADES—Illustrated—By Walter W. Kane 373

CONCRETE IN SEA WATER 374

EDITORIAL NOTES 375

Refuse Collection Records—Federal Business Conservatism Desirable—Efficiency Means Profit on Small Jobs

Engineers Wanted for Reclamation Service 376

OREGON STATE HIGHWAY NOTES—Illustrated 377

Pennsylvania Highway Contracts Let 378

Patching Concrete Pavement in Macon 379

War Deterioration of Water Plants 379

ROAD WORK IN 1920 AND 1921—Table 380

What Are the Essentials of Cost Keeping on Contracts 382

The Staten Island Tunnel 384

RECENT LEGAL DECISIONS 385

Refuse Collection Records

"I do what has to be done as well as it can be done and keep the cost down as much as possible. Why increase my work and the costs by weighing, counting and keeping records of everything?" This in effect is the excuse offered by many a public official for not keeping records. In other cases it is the reason given by the council or other money-appropriating body for refusing to give the superintendent of a municipal service the appliances and assistance necessary for keeping records, even when he, realizing their importance, is anxious to assume the additional work involved.

In the case of refuse collection and disposal, the records are easily kept and are of great use in securing maximum efficiency and economy of service, and yet too few cities keep records that are at all accurate and reliable. Some of the uses of such records that immediately suggest themselves may be considered with profit.

The fundamental record is that of amount of refuse collected. From this we can learn which wagon or other collecting unit is performing the most service, and which is loafing or is so routed that it cannot work full time effectively. By knowing this, a modification of routing may be possible that will save thousands of dollars a year. There should be continous records of the amount collected each day by each driver and the time he delivers each load of refuse at incinerator, dump or other disposal point. With this information in hand and a knowledge of the routes of each wagon, the routing can be modified from time to time so as to maintain maximum efficiency.

Again, in the case of incineration of refuse the efficiency of the incinerator can be known only when the amount of refuse burned is known. Without this it is impossible to know whether it is meeting its guarantee; or to compare it with another of a different type so that, when the time comes to increase the capacity of the plant, the most economical and efficient make can be chosen. Also records of the amounts burned inform the superintendent whether one man operates a furnace more effectively than another, or whether the operator is improving or becoming slack in operating it.

Every load should be weighed. It is impractical to expect a wagon to always collect just a struck load, or always the same amount, and counting wagon loads with an occasional weighing is likely to give errors of 25 per cent; which error will not be greatly reduced by having an employee estimate the percentage each load is of a struck load. In the case of rubbish, a driver can easily double or halve the space occupied by a load by skilful packing or by breaking up boxes, barrels, etc. But the scales cannot be so deceived.

Without regular, continuous weighing of refuse it is not possible to insure maximum efficiency and economy in either collection or disposal by incineration or reduction, nor to intelligently plan for future extensions of service.

Federal Business Conservatism Desirable

Adverse criticism of Federal business, especially that of engineering construction, has sometimes been almost a favorite indoor sport among those smarting from restrictions, delays and decisions that they consider unnecessary and injurious. The contention, however, that public work is generally slower and more costly than private work of the same character is not always true, and when true, is sometimes justified. In order to safeguard public work it is necessary to limit it by many restrictions that have been developed by necessity and long experience. It is impossible to grant to subordinate officials sometimes necessarily poorly qualified political appointees the discretionary powers that may be allowed competent assistants in private work, or to take the risks with public money and public interests that the individual is free to assume for himself.

Critics should realize that in the complicated and varying requirements of engineering construction it is impossible to predetermine all the factors or to arrange in advance for the best good and satisfaction of all the different interests involved. Some private interests will sometimes suffer but it is the duty of the government to protect the public interests and property and to reduce to a minimum losses that it is impossible to fully eliminate.

To do this, careful regulations must be thoroughly and positively enforced, leaving little discretionary power. When this is realized and contractors carefully study the conditions and requirements in advance and are fully prepared to live up to the strict letter of the specifications and contracts, their risks and difficulties will often be found less than in private work. In general the disposition of Federal officers is to get good work, live up to the written requirements, and treat their contractors fairly.

In a recent illuminating address on "The Business of Government," Judge W. W. Warwick, Comptroller of the Treasury, said that the superiority claimed for commercial organizations over established and time-tested methods of government procedure has not been demonstrated; that administrative rules and regulations are required for the performance of all Government business; and that the present condition is as it should be with the safeguards for the interests of the people themselves. He believed that the criticisms of the cost-plus contracts were not justified and he had seen no examples of the system where the contractor got the better of it. Examination has not shown that contractors preferred to pay double wages in order to increase their profits. He believed in a National budget, in the reorganization of the Government executive department, and that the better positions should be given to those willing to make public service a life work.

Efficiency Means Profit on Small Jobs

In a large job where the overhead is heavy and time is of the essence, rapidity is recognized as a very important factor of success and the loss due to an interruption of even half an hour delaying a large force of men is easily understood. In such work there is a good chance for consistent effort to be made, to have the work systematic and well co-ordinated. When this is thoroughly accomplished the contractor seldom makes a profit of more than 20 or 30 per cent on the gross cost of the work.

On small miscellaneous jobs which are often scattered the contractor is properly entitled to make much larger percentages of profit, and if he has plenty of work and does it well he should, besides paying himself a handsome salary, turn over his invested capital very much more rapidly than does the large contractor. To do this most successfully he must keep his plant, equipment and organization constantly at work under advantageous conditions, probably the most difficult result to accomplish and one that is seldom fully achieved.

The small contractor's first aim should be to select a satisfactory line of work, and then to equip himself perfectly for executing it most cheaply and thoroughly train his men to do it in the best and most efficient manner, prepare an advanced schedule for all their operations so that there will be no interference, and secure all materials and supplies at the moment that the work and the men are ready. If this is done the profits will take care of themselves and the contractor will rapidly grow until he can undertake larger and larger work corresponding to his increased resources and reputation.

A large amount of construction work involves concreting and there may be often several simultaneous or immediately succeeding jobs requiring it, that are located from one to thirty miles apart. The delivery of sand, stone and cement by rail is an uncertain and costly operation, delivery by special trucks is also costly and so is mixing by hand for small quantities, even if it is permitted, which is not often the case. A small concrete mixer is not often available for immediate rental in remote localities and its railroad shipment to the place puts it out of service for several days and requires an uncertain amount of time besides the cost of transportation. All of these difficulties have been very satisfactorily overcome by an expedient described in the April 9 issue which is so simple and obvious that it commends itself for a large number of purposes.

A complete storage plant and concrete mixing and spouting equipment is installed on a large automobile truck, making it rapidly portable and giving it a large radius of application. This little plant could transport all of the materials and equipment necessary for a large proportion of ordinary small jobs, together with the men and tools necessary to execute the work, and if these did not suffice could easily be accompanied by a trailer providing the necessary additional transportation at very small cost and no loss of time. Such a peripatetic plant can easily cover an ordinary county, building culverts, pavements, foundations, retaining walls, small bridges and the like to great advantage.

Engineers Wanted for Reclamation Service

Engineers are wanted by the United States Reclamation Service at salaries ranging from $2,400 a year to $1,200. The positions to be filled are those of irrigation engineer, civil engineer and assistant and junior of each of these, and an engineering draftsman. In addition to these salaries, there is a bonus of $20 a month. Applications will be received until August 1 by the United States Civil Service Commission at Washington, D. C., to which applications for examinations may be addressed. The examination will be in effect a sworn statement of the applicant as to his education and experience in irrigation or civil engineering. Those desiring to apply should ask for form 1312 and state what position they desire to apply for.

Oregon State Highway Notes

Some of the more important and interesting points noted in the 1919-1920 Report of the State Highway Commission.

Standard Construction. Standard bituminous construction consists of gravel or crushed rock macadam sub-base, 3-inch bituminous base, and 2-inch bitulithic wearing surface. Standard concrete construction is from six to seven inches thick, the thickness depending upon the traffic to be carried and the character of the sub-grade. Steel reinforcing is used where foundation conditions are unstable. The standard pavement section is 16 feet wide with extra width on curves and superelevation. Two-foot shoulders of crushed rock or gravel have been constructed on all pavements.

It is necessary that all new grades be allowed to settle and be open for travel for at least a year and preferably longer before paving to secure the best results, which will explain why some gaps in the main highways have been left unpaved.

Macadam has, in general, been built 16 feet wide, though in some instances where lighter traffic is expected, 14, 12 and 8-foot widths have been used. The standard width of graded roadbed in average work has been 24 feet, including ditches, and this has been widened to 30 feet in open country where a grader section can be used, and narrowed to 16 feet, including ditches, in the sparsely settled districts and lesser traveled roads where a greater mileage with the funds available was advisable, leaving the widening to a future date when traffic demands.

Work by State Forces. The total of all construction work done direct with state forces totaled in cost $447,850.18, or about 2½ per cent of the total cost of all work done. This work has consisted of grading, macadamizing and bridges, some of which were carried over from the 1918 season. All of these jobs were first advertised and the bids considered unsatisfactory.

Beautifying Highways. The matter of beautifying the highways has had consideration from the commission and it is thought that this feature should be given more attention in the future. The proposal to plant trees along the highways as well as the plan to secure a belt of standing timber on each side of the roadway through the forests and thus preserve the natural beauties for later generations is heartily supported by the commission. Also alongside of the highways are many ideal camping places. It is thought that some means should be taken to secure a reasonable number of these choice spots for camp sites which need not be large but sufficient in size to accommodate several camping parties.

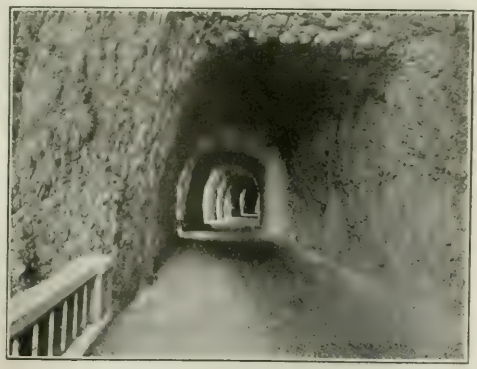
The commission has instructed its engineers to remove all advertising signs within the highway limits as provided by the law so that the highways themselves are free from advertising except, of course, those signs which are on private property.

Oiling Sand Slopes. An interesting feature of the work along the Columbia river between The Dalles and Pendleton treated as a maintenance feature has been spraying of crude oil on the slopes of embankments and excavation as well as alongside the highway to keep down drifting blowing sand. This work in connection with similar work by the railroad has been very successful.

Engineering Expenses. It is thought that the engineering expenses for the years 1919 and 1920 will compare favorably with the costs in other states. The administration and supervision amounted to 1.76 per cent of the total expenditures; the surveys for state highways, 2.04 per cent; construction engineering, 5.11 per cent; engineering on county construction, 0.44 per cent; market road engineering, 0.14 per cent; or a total of 9.49 per cent for the two-year period.

Columbia River Highway. While the surfacing of the Columbia River highway has represented a task of considerable magnitude, the grading of this great highway has not only been much more costly than the surfacing, but has presented much greater difficulties. For many miles it has been necessary to construct the roadbed for this highway upon the rugged and almost vertical walls of the Columbia River Gorge, necessitating that the roadway be literally carved out of the solid rock. In many places the rock bluffs overhang the finished highway, and at no less than six places it has been necessary to tunnel through rock points which could not otherwise be overcome. For almost its entire length, the highway presents a series of concrete bridges, rock walls, overhanging rock bluffs, tunnels and other construction features of great interest from an engineering as well as from a scenic standpoint. The grading of this highway, now practically complete, represents what is probably the most difficult and costly piece of highway construction yet undertaken in America.

(Compare with the last sentence the following from the 1920 report of the New York Highway Commission, referring to the road along the face of Storm King, which cost $697,505 for 4.03



MITCHELL POINT TUNNEL, OREGON

miles: "This will be the highest cost road not only in this state, but in the United States.")

Bituminous and Concrete. Following out the apparent intent of the legislature as expressed in the several laws governing state highway work, the Highway Commission in awarding paving contracts has made it a practice to consider, on a competitive basis, two or more types of pavement for each paving job. Every job has been thrown open to competitive bidding on both concrete and bituminous pavements, and the award has always been made for the type upon which the lowest total bid was received. The thickness and general make-up of each type has necessarily varied with the condition of sub-grade, the character of available materials, and the class of traffic to be carried, and there has been a gradual tendency toward heavier types of pavements to meet traffic conditions which are continually becoming more and more severe.

Except where sub-grade conditions are unusually favorable, as on sections having heavy gravel or broken stone surfacing of sufficient width and at proper grade to form an absolutely rigid foundation, it is now standard practice to specify for bituminous pavement a thickness of 8 inches consisting of a 2-inch bituminous wearing surface, with a 3-inch bituminous base, on a 3-inch broken stone macadam sub-base, and for concrete pavements, a thickness of 7 inches. It is generally considered that there is little to choose between these two types of pavement, each type having advantages over the other under certain circumstances.

From the standpoint of cost, the two types of pavement are as nearly competitive as it is possible to obtain. While most of the pavement constructed by the Highway Commission has been of the bituminous type, no less than 55 miles of concrete pavement has been placed under contract during the past two years. The chief factor which has operated to throw the majority of contracts to bituminous types of pavement is that the paving contractors in this state have been better equipped to lay bituminous pavements than concrete, and for this reason only a very limited number of contractors have been in a position to bid on concrete pavements.

A factor which prevents concrete pavements from being laid more cheaply than bituminous pavement is the excess price which must be paid for cement in this state. For some reason not accounted for by higher cost of production, the price of cement in Oregon has been very materially higher than in either Washington or California. It is practically impossible to secure a basis for comparison of cement prices, but a conservative estimate places the discrimination against Oregon buyers at not less than 20 per cent.

The average cost of pavements completed during 1919 and 1920, based upon final paid amounts under all completed pavement contracts, an aggregate of 189.1 miles, was $1,210 per mile per foot width. This average cost is for pavement and pavement base. It does not include the cost of grading, shoulder construction and engineering.

Broken Stone and Gravel Surfacing. It is the general practice of the department to construct broken stone and gravel surfacing of materials having a maximum size of one and one-half inches. In most cases the materials are separated into two sizes, the base course of the surfacing being constructed from the size from three-fourths of an inch to one and one-half inches, and the top course from the size from three-fourths of an inch to dust. In general, the surfacing is not rolled, the compacting being effected by hauling over the materials as they are placed, with dragging at frequent intervals as the hauling progresses.

It has been found that the construction of waterbound macadam is not desirable, due to the difficulty with which it is maintained. The broken stone or gravel surfacing as laid by the department, with fine materials on top, affords a very good traveling surface and can be easily maintained by dragging. The use of no materials larger than one and one-half inches in size, even in the base course, prevents any possibility of large stones coming to the surface as a result of maintenance operations.

This method of construction cannot, of course, be used under all conditions. Where the subgrade is unusually soft and unstable, it is frequently found to be desirable to use a somewhat larger size of material in the base or to construct a sub-base course of coarse material. It is occasionally found necessary, particularly in the construction of gravel surfacing, to sprinkle the materials as they are placed to assist in compacting.

Broken stone and gravel surfacing has cost on the average about $450 per mile per foot width.

During the year 1919 only five states constructed more miles of paved highways than did Oregon. During the same year only four states expended more state money for road purposes, although in several other states the combined amount of state, federal government and local funds expended under the direction of the state authorities was greater than the combined amount of Oregon.

For the year 1920 complete statistics of expenditures and completed mileages are not available, but it is quite certain that Oregon will rank as high, if not higher, than in 1919. In amounts of state funds available for highway work during 1920, Oregon stood fourth among all the states.

Pennsylvania Highway Contracts Let

Following the rejection of all bids for highways, as noted in our issue of March 19, bids were received by the state highway department of Pennsylvania on March 31 and April 1, and 21 contracts were awarded involving the construction of nearly 84 miles of highways. These contracts are for lengths varying from a minimum of 5,873 feet to a maximum of 39,959 feet, the former having an estimated cost of $89,578 and the latter of $449,940. The costs ranged from about $54,000 to $80,000 a mile, with the majority ranging between $60,000 and $70,000. Mercer county is to receive five of the roads covered by these con-

tracts, on three of which the county commissioners pay the entire cost of construction, involving something over $1,000,000; on a fourth the entire cost is paid by the state, and on the fifth the state pays 50 per cent and the county and two townships split the other 50. In a number of cases where the highways contracted for are within the limits of boroughs, the department pays for 18 feet of width and the boroughs themselves for the additional width.

Patching Concrete Pavements in Macon

One of the difficulties found with the upkeep of concrete pavements is the patching of holes made in the same by wear, or especially those cut in the pavement in connection with the laying of street mains, house connections, etc. The chief paving inspector of Macon, Ga., W. L. Ashmore, believes that by the method employed in Macon such openings can be closed more cheaply and with less evidence of the patch than can be done with any other type of pavement.

Anyone making a cut in the pavements of Macon must first secure a permit and furnish a bond. The cutting of the pavement is done by the parties concerned, but the refilling of the trench and replacing of the pavement are done by city forces under the supervision of Mr. Ashmore and the cost of the work billed against the beneficiary.

First the backfilling is made carefully and thoroughly compacted. The edges of the cut in the pavement are trimmed with a chisel to a depth of one inch below the surface, to secure a vertical edge and eliminate any feather edges at the wearing surface and disintegration around the edges of the patch. Below this inch of trimmed edge the jagged edge is allowed to remain, except that all loose particles are removed and the concrete is thoroughly cleaned and wet before the new concrete is put in place.

The concrete replaced is mixed 1:2:3, the same proportion as the original pavement, and as nearly as possible the same kinds of aggregate are used. Only enough water is used to secure a plastic mix. The new concrete is carried ½ to ¾ inch higher than the pavement surface and is immediately tamped. After 15 to 30 minutes it is again tamped, and this is repeated after another interval of 15 to 30 minutes, the time between tampings being determined by weather conditions. The repeated tampings are considered of special importance as the feature most responsible for securing a perfect bond with the old pavement for its entire thickness. Mr. Ashmore believes fresh concrete will not compact the entire thickness on first tamping, but after it has been allowed to stand for some time the subsequent tampings compress the material firmly against the walls of the old pavement. By the repeated tampings and compressions performed at a time when the concrete has lost some of the plasticity, it is worked and condensed until there is no further shrinkage and a perfect bond is secured with the old pavement. The concrete is then finished with a hand float which is pressed down with sufficient weight to still further compress the fresh concrete. A perfectly uniform surface is secured by striking off the patch with a straight-edge. The fresh concrete is then covered with dirt, which is wet down at intervals and is protected from traffic for four days.

The average cost of these patches has ranged from $3.50 to $5 per square yard, depending upon the size of the patch. Mr. Ashmore reports that patching other types of pavement in that city costs from $6 to $10 per square yard.

War Deterioration of Water Plants

In a recently issued report of the bureau of water of Reading, Pa., is a discussion by Lewis J. Early, record clerk, of the statistics of 29 cities which publish reports in the form recommended by the New England Water Works Association, which data had been compiled by him and were published in tabular form. Only three cities—Erie and Allentown, Pa., and Colorado Springs—metered less than 28 per cent of the services, and only five metered less than 50 per cent. The amount paid by consumers per thousand gallons averaged 10¼ cents, ranging from 3.89 cents in Allentown to 28.5 cents in Reading, Mass.

One of the most significant points noted by Mr. Early, however, was the effect of war prices and economics on the conditions of the plants. Said he: "There is one very striking feature that marks all the reports. That is, the admission that plants have deteriorated." Some reports explain that, owing to the war, there have been no improvements or enlargements, few replacements and a minimum of repairs. Others assign these degenerate conditions to high cost of material and the shortage of labor, and still others to politics, indifference or incompetency. Whatever the cause, the reports are almost a unit in bewailing the failure to keep rates at the proper ratio to maintenance cost, with a sufficient margin to provide for future needs.

"The following excerpt from the report of the superintendent of water works of Lowell, Mass., a city in Reading's class as to population and character of plant, is typical: 'If the department receipts would warrant it, many improvements could have been made; in fact, several times the amount of money expended could have been used for upkeep, not to speak of new work urgently needed. Naturally, the increase in the cost of labor and material has made matters worse, but the basic trouble is due to the fact that the water rates are too low, and until they are increased the necessary maintenance, renewal and construction work of the department is bound to suffer, and the condition of the property, as a water works plant, to deteriorate so that poor service to the public will inevitably follow.'"

Road Work in 1920 and 1921

Last month we obtained, through the courtesy of county and state highway officials, data concerning highway work throughout the United States. Part of this was published in our April 16 issue, the remainder will appear during the next few weeks. In this issue we give the first installment of a table telling the kind and amount of road work done in 1920 and the money spent; also the amount of money available for 1921 and how it is expected to be used. There is also stated the kind and amount of work done in each county by contract and by public employees, respectively, and what it is expected to do in this respect in 1921. The quantities of work are in miles or square yards, unless otherwise stated.

WORK DONE DURING 1920 AND CONTEMPLATED DURING 1921.

Note—Quantities are given in miles or square yards (the size of the number indicates which) unless otherwise stated.

	During 1920			During 1921		
County and State	Money spent for hwy. work	Kind and amount of surface laid	Amt. done by contract & by employees C—contract E—employees	Money available for hwy. wk.	Kind & amt. of surface to be laid	Amount to be done by contract and by employees C—contract E—employees
Alabama:						
Calhoun	$122,532	Grading ½	All E	$50,000	Only maintenance	all E
Conway	750,000	mac., 6, gravel 8, crushed rock 25	all E	600,000	mac. 22, gravel 5, 50 mi. prob. mac.	all C
Jefferson	.....	131.279 warrenite bit.	....	.....	.....	.....
Monroe	21,601.64	gravel 7	all E	$350,000	gravel 24¼	all C
Montgomery	325,000	conc. & maint. of 450 gravel	$90,000 bridge C rest all E	200,000	maint.	all C
Pike	60,000	45.000	all C	60,000	.....	all C
Arizona:						
Flagstaff	.....	6.000 war.-bit.	....	.....	.....	.....
Maricopa	.....	15.444 war.-bit.	....	.....	.....	.....
Yuma	.....	1.010 war.-bit.	....	.....	.....	.....
Arkansas:						
Arkansas	.....	39,667 war.-bit.	....	.....	.....	.....
Jackson	400,000	gravel 30	all C	400,000	gravel 30	all C
Lincoln	100,000	gravel 20	all C	Indef.	gravel 33 1-3	all C
Lincoln, Drew, Desha, Chicot & Ashley	1,500,000	broken stone 12, mac. 20, topeka 50	all C	1,225,000	gravel mac. 50	all C
Phillips	.....	24,499 war.-bit.	....	.....	.....	.....
Polk	45,000	gravel 9	all C	500,000	gravel 50	all C
Pulaski	2,250,000	conc. 6, asp. conc. 10 warrenite 7, sh. asp. 3	all C	3,500,000	asp. conc. 18, conc. 22, 2 bridges	all C
Saline	170,000	gravel 20	all C	Indef.	gravel 33 1-3	all C
Scott	15,000	none	....	40,000	repair & maint.	all E
Sevier	110,000	gravel 20	all C	Indef.	grav. 33 1-3	all C
Van Buren	200,000	grading & drainage	all C	100,000	19 mi. started in 1920	all C
California:						
Fresno	2,150,000	asp. conc. 65, mt. rd. reconstr. 50	mt. rd. 50 E asp. conc. 65-C	2,650,000	asp. conc. 70	all C
Glenn	150,000	conc. & oil mac.	all E	160,000	.....	all E
Madera	70,000	dirt, gravel	all E	80,000	.....	all E
Santa Cruz	.....	16 conc.	....	.....	20 conc.	.....
Solano	190,000	repairs 45, conc. 1	....	350,000	$37,000 asp. conc.	.....
Sutter	269,838.18	3½ conc., 15 asp. mac.	½ asp. mac. E rest C	760,000	6 conc., 33 asp. mac.	5 asp. mac. E rest C
Ventura	600,000	14 bit., 13½ cem. conc.	all C	200,000	14 asp. surfacing, 5 grading, 2 oil mac.	½ E. ½C
Yuba	.....	1.757 war.-bit.	....	.....	.....	.....
Colorado:						
Elbert	119,000	gravel and dirt	30 gravel E	92,000	50 dirt	½ E. ½C
Logan	206,518.30	3 415 lin.ft. conc.	all C	216,657.47	4½ conc.	all C
Ouray	40,000	$1,000 gravel	all C	180,000	$5,000 gravel	gravel E
Rio Blanco	110,000	20 shaled surf.	all C	60,000	1.8 shaled, 10 earth	all C
Rio Grande	125,000	gravel & sand mix.	$40,000 E $85,000 C	128,000	3.5 fine gravel & sand mix	all C
Routt	90,000	earth	67,000 E 23,000 C	160,000	7 gravel & dirt, 1¼ gravel surface	F. A.-C earth E
Wild	455,000	13 gravel, 1¾ conc.	all C	599,000	5 conc., 7 mac.	all C
Connecticut:						
Bethlehem	10.000	all repair	½ E, $1.000 C	20,000	all repair	all E
Greenwich	150,000	2 conc., 2/3 tarvia penetration	2/3 tarv. E 2 conc.-C	180,000	3 conc., ½ pen.	pen. E, conc. C
Hamden	25,000	½ topeka asp.	all C	280,000	5 cement	all C
New Haven	5.000	gravel	all C	25,000	2 tarvia top	all C
New London, Windham	671,705.41	34.747 ft. mac., 2,600 ft. conc., 18 290 ft. gravel	24,205 ft. E 167.060 C.	1,370.000	15 bit. mac., 8 conc., ½ rock mac., 4¼ mac.	1-E. 2⅔ C
Tolland		106,653 ft. bit. mac., 28,975 ft. rock mac.				
Southington	.....	4.692 war.-bit.	....	.....	.....	.....
Florida:						
Bay	80,000	60 clay-gravel	all C	.....	.....	.....
Bradford	815,000	sand and clay	all E	180,000	.....	all E
Brevard	.....	.....	.....	.....	20 mac.	
Duval	200,000	shell	prisoners	300.000	$50,000 asp., rest mnt.	maint. E. rest C
Escambia	118,000	1 cem. conc., 3 bridges	$20,000 E $98,000 C	2,044,000	80 class A const.	all C
Flagler	75,000	grading, hard surfacing	$45,000 C $30,000 E	200.000	hard surfacing	all C

WORK DONE DURING 1920 AND CONTEMPLATED DURING 1921 (Continued)

County and State	During 1920: Money spent for hwy. work	Kind and amount of surface laid	Amt. done by contract & by employees C—contract E—employees	During 1921: Money available for hwy. wk.	Kind & amt. of surface to be laid	Amount to be done by contract and by employees C—contract; E—employees
Florida (continued):						
Pinellas	157,000	5 vitr. brick, 4 oyster shl.,4 lime. rk shlds.	$57,000 E 1,000,000 C	$7,000	5 lime rock base w. oyster shell finish	all E
Idaho:						
Ada	600,000	10 bit., rest gravel	gravel E 10 bit. C	600,000	3 bit., 6 conc. or bit., rest gravel	all C
Bannock	196,277	15 gravel, 15 crushed roc k	earth & 10 grav. E rock & 5 gravel C	250,000	probably like 1920	all E
Bingham	.....	65,000 war.-bit.	.....	.....	.....	.....
Boise	21,000	8 dirt	all E	100,000	20 dirt	all C
Bonneville	.....	56,000 war.-bit.	.....	.....	.....	.....
Butte	40,000	earth & gravel	$5,000 E $35,000 C	55,000	5 graded earth, 10 gravel	3 earth, 2 grav.-E 2 earth, 3 grav.-C
Carbon	102,243.54	grading & drainage	3 C rest E	none	grading & maint.	all E
Custer	6,000	maintenance	.....	96,000	6 grading	all C
Dist No. 1, Bureau Hwys.	340,000	15 gravel, 7 crushed rock, 35 earth grade	26 earth-E 31-C	320,000	1 rock, 20 gravel, 20 earth grade 7 conc.	10 E, 20 grad., 21 surface C
Filer Hwy. Dist.	.....	.....	.....	.....	.....	.....
Idaho	425,000	4 mac., 32 earth	all C	528,000	5 mac., 26 earth	all C
Power	120,000	25 gravel	....	158,000	15 gravel	all C
Illinois:						
Adams	150,000	2 mac., 6 gravel	3-E	170,000	30 earth, 35 conc., 3 gravel	gravel, earth E conc. C
Calhoun	none	.....	....	200,000	.....	all C
Carroll	25,000	5 gravel & mac.	all C	6,000	1 mac.	all C
Christian	none	.....	....	60,000,000	oiled earth 200	100 E, 100 C
Clark	622,000	concrete	all C	450,000	gravel or rock	all C
Coles	133,000	1 brick pave., 10 grav.	all C	135,000	1 brick pavement, 10 gravel	all C
Crawford	140,000	1¼ gravel mac., 7 gravel, 3 oiled	2 grav., 3 oil-E rest C	140,000	10 gravel, 2 oil	10 gravel C
De Witt	100,000	50 earth	....	150,000	240 oiled earth	all E
Fulton	250,000	.....	....	Indef.	.....	.....
Henderson	87,560	earth	all but bridges E	92,900	earth-conc. bridges	all C
Jackson	50,000	grading, bridges	50,000 E all C	125,000	8 gravel	all C
Jasper	none except bridge work	.....	....	none	1¼ gravel by twp.	all C
Jersey	51,000	.....	....	34,000	11 conc.	all C
Kane	360,000	10½ conc.	all C	1,100,000	7 conc.	7½ C
Madison	850,000	6½ brick, 22½ conc.	all C	257,000	very little	all C
Marion	.....	earth, $50,000 bridge	all C	.....	no hard road	bridges E
Massac	150,000	gravel	road dists. E 50% C	125,000	150 gravel	all C
McDonough	200,000	400 earth	70 E, rest twps.	200,000	400 earth	70 E, rest twp.
McHenry	222,000	1 conc., 3 bridges	all C	500,000	10 gravel, bridges 10 gravel bridges	bridges, hauling C
Monroe	42,000	3 mac.	2 E	45,000	3 mac.	all E
Piatt	20,000	.....	all C	40,000	.....	all C
Pike	12,000	gravel	½ E, ½ C	50,000	gravel	all E
Pulaski and Alexander	60,000	5 gravel	1½ C	375,000	30 gravel	all C
Richland	30,000	.....	....	35,000	earth-conc. bridges	twp. comrs.
Saline	none	.....	....	120,000	8 mac.	all C
Schuyler	75,000	concrete	100% E, 50% C	Indef.	1-15 conc.	most E
Scott	15,000	bridges, culverts, etc.	all E	10,000	oiling earth, bridges	3 E, 5 C
Stephenson	200,000	$100,000 bridges, rest earth roads	$50,000 E $100,000 C	450,000	5 conc., 3 rk. & grav.	
White	30,000 twp.	gravel	all C	40,000	gravel	all C
Williamson	60,000	3½ mac.	all C	105,000	.....	all C
Woodford	.....	7 graded earth	all C	10,000	4 graded earth	all C
Indiana:						
Clinton	281,781	8 grav., 3½ brick, 2 conc.	all C	1,005,852	15½ gravel, 5¼ brk. 16.67 conc.	all C
Crawford	20,000	5 mac.	all C	250,000	43 mac.	all C
Decatur	240,000	3 conc., 6 stone	all C	.....	8 conc., 12 stone	all C
Dubois	40,000	4 mac.	all C	300,000	30 mac.	all C
Fulton	100,000	gravel	all C	500,000	50 miles	all C
Howard	150,000	1 conc., 6 mac., 5 grav.	all C	600,000	½ asp., 7 conc., 8 stone, 15 gravel	all C
Jackson	200,000	gravel, mac., conc.	all C	150,000	5 gravel, 4 conc.	
Jennings	55,000	gravel, mac.	all C	63,000	gravel, 5 mac.	all C
Madison	123,000	concrete	all C	.....	$738,000 conc., $112,000 gravel & mac.	all C
Montgomery	.....	2 gravel rds.	all by twp.	.....	.....	.....
Morgan	175,000	½ mac., 10 grav., 8 stn.	all C	150,000	20 gravel & stone	all C
Newton	.....	1 mac.	all co. contract	800,000	73 mac.	all C
Posey	.....	15 gravel	....	.....	20 gravel	all C
Putnam	275,000	5 concrete	all C	550,000	20 mac., 10 gravel	all C
Ripley	32,100	1½ crush. stn., 1 con.	all C	300,000	7 conc., 20 stone	all C
Shelby	170,000	$30,000 stone, $35,000 conc., $105,000 gravel	all C	190,000	$96,000 stone, $15,000 conc., $79,000 grav.	all C
St. Joseph	300,000	3 concrete	all C	2,500,000	24 conc., 24 asp. pen., 20 gravel	
Tippecanoe	305,000	10 gravel	all C	800,000	6½ bit. conc., 1 asp. pen., 3 tarv., 2 grav.	all C
Vigo	1,050,000	2 gravel, 4 conc., 1½ brick, 1 vibrolithic	$20,000 state $105,000 co. all C	7,000,000	25 brick & vibrolithic 40 gravel	tarvia E, rest C all C
Iowa:						
Allamakee	70,000	none	....	185,000	$30,000 grade work, $30,000 grd. & mnt.	maint. E. $30,000 C
Appanoose	227,856.34	dirt	116,830 E, 111,026 C	200,000	200,000	90,000 E, 110,000 C
Beton	78,000	.....	all E	400,000	9 conc.	all C
Bremer	60,000	.....	....	160,000	11½ grading, 17 fed. aid	all C
Buena Vista	1,280,000	51 gravel	12 E, 39 C	140,000	20 gravel	6 E, 14 C
Cass	107,450	none	all E	235,530	none	$125,800 E

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems different will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

Value of Answers to Construction Questions

B. M. CRENSHAW
General Contractor
Livingston, Mont.

April 11, 1921.

PUBLIC WORKS,
243 W. 39th Street,
New York, N. Y.

GENTLEMEN:

Recently you published under "Construction Questions Answered," our correspondence in regard to the classification of hand rail concrete. This publication has become quite valuable to me as it has been the means of my obtaining from the State Highway Commission the proper classification of the hand rail cement. However, my copy has disappeared, and I think that the highway engineers have probably, after reading same, placed it in a coat pocket and forgotten to return it.

I should like to obtain about five copies of the magazine which contains the article mentioned, as I wish to send one to a consulting engineer on a big project in Canada, and other engineers of my acquaintance. . . .

I certainly appreciate the help that you have been to me in this connection. Your magazine is read in my works by all the men, and the article about the hand rail received much comment.

Thanking you most sincerely, I remain,

Yours truly,
B. M. CRENSHAW.

What Are the Essentials of Cost Keeping Accounts?

Flexible system of classification and subdivision of items, accurate records, simple key system, distribution of overhead and fixed charges, low cost and immediate availability, automatically showing condition of work and comparison with estimate.

Portland, Ore., March 15, 1921.

PUBLIC WORKS,
243 W. 39th Street,
New York City.

Gentlemen: We are figuring on making some changes in our methods of time-keeping and cost accounting on 1921 contracts.

No doubt you are in touch with some firm who has already worked out forms suitable for handling detailed costs on sewer, water and road construction work. If so, we will be pleased to have you request them to communicate with us, sending sample forms, time sheets, etc.

Thanking you in advance, we are,

Yours very truly,

* * * * *

Cost keeping is essentially intended to provide detailed data regarding the cost of different items of construction, so that they may be readily accessible, separately and classified, for the entire work and available for exact records of the work already done and for rational estimates of similar work or as a basis or modification of estimates for work which differs in amount or conditions from that already accomplished.

REQUIREMENTS FOR DATA

The records must, therefore, give complete information regarding all portions of the work in such a manner that they can be segregated or combined, not only to cover the different structures or parts of structures, but so as to give the amounts and unit costs of different sorts of primary operations, such as excavating, concreting, pile driving and the like.

The degree of refinement, and consequently the amount of detail in the accounting, varies widely with the class of construction and local conditions and still more with the arbitrary requirements of classifications. Many of the operations also can be considered as simple or compound items or they can be treated as a number of supplementary items, as, for instance, in rock excavation, where, if there is only a comparatively small quantity executed at brief intervals by men temporarily released from other operations, it may be only necessary to record the total number of man-hours required, total costs of explosives and of yardage excavated; while for other cases it may be necessary to record also the character of rock, dimensions of cut, time spent in stripping, drilling, loading, firing, mucking and loading, details of supplies and equipment, and other information.

In any event, the amount of detail should be carefully determined so as not to be in excess of the requirements and still to give all essentials for the specific class of construction or kind of operation. The classification should be determined in conference with the estimator that will use them and in accordance with classifications and unit prices in the specifications and standard for this class of work.

DIRECT AND INDIRECT

The classified cost includes not only the direct but the indirect items that enter into the finished work. They must therefore embrace labor, materials, supplies, equipment, supervision, overhead and fixed charges. A definite system must be devised for distributing the latter classes of costs so as to provide a fair apportionment and not omit important factors that are sometimes

overlooked and may make all the difference between profit and loss.

Overhead charges may be considered as those that belong essentially to the general established business of the contractor and are not special for this particular job, but apply to other work under construction by the same party. Overhead charges should include the percentages carefully calculated that this job must pay toward the maintenance of the central office, legal and contracting expenses, general transportation, salaries of all general officials, emergency funds, interest, maintenance, amortization fund, if any, and, in fact, all expenses necessary to carry on the general business irrespective of any particular contract.

Fixed charges cover those necessary expenses not included in the direct outlay for labor, materials, supplies and equipment not dependent upon the system of operations or items of work, as, for instance, premium on surety bonds, interest on borrowed money, fire and accident insurance policies, local rent, camp and hospital charges, commissary and local office expenses, special appropriations for explorations, general supervision, royalties, licenses, permits, replacements and delays.

SUPPLIES, MATERIALS AND EQUIPMENT

Supplies and materials should, of course, be charged and credited as per the stock account kept, showing when ordered, received, inspected, stored, requisitioned, used and returned, with shrinkage and depreciation. This provides an automatic perpetual inventory, the same as should be maintained for equipment.

A very careful account should be kept of all equipment, including machinery, tools and plant of every description, whether permanent plant, or purchased and sold at the beginning and end of the job, or rented, or built, or rebuilt, and items repaired or resold. Liberal depreciation allowances should be attached to record of time plant was actually in service and charges for idle time. The cost of hauling, handling, installation and removal, operating, supplies, renewals and repairs should also be kept.

SYSTEM OF CLASSIFICATION

The main heads for classification of costs of highway construction might include, for example, fixed charges, overhead, supervision, accounting, purchasing and inspection, transportation and freight, machine equipment, small tools, fuel, materials and supplies, auxiliary construction, temporary construction, commissary, hospital, repairs and renewals, rock excavation, earth excavation, embankment, hauling earth and rock, unloading materials, storing materials, delivery of materials, mixing concrete, placing concrete, finishing concrete, protecting concrete, water supply, ditches, culverts, retaining walls, hand rail, curbs, gutters, producing sand and stone and miscellaneous.

Labor should, of course, be classified according to trades and the amounts charged to different operations on various kinds of construction, as aforementioned, should exactly balance the total time reported.

SUBDIVISIONS OF OPERATIONS

The number and character of the items depends entirely on the requirements of the classifications. The concrete mixing may be assumed as a single unit or it may be divided into installation of mixing machine, operation of machine, power and oil for machine, removing machine, measuring and delivering sand, gravel, cement and water, protecting materials, heating materials, etc.

The concreting may include setting and removing forms, delivery of concrete, spreading and leveling of concrete. Finishing the concrete may include rolling, ramming, belt finish, making expansion joints, protecting with screens, covering with earth, watering, removing earth, miscellaneous.

EQUIPMENT AND MAINTENANCE

Under Equipment, the heading Automobiles and Trucks may include superintendent's car, service car, trucks of various sizes and patterns, trailers, extra parts, gasoline, oil, tires, garage rent, labor in machine shop, machine shop overhead, chauffeurs, mechanics and helpers, light, insurance, depreciation and miscellaneous.

Accounts should be kept for concrete mixers, hoisting engines, compressors, boilers, pumps and engines, dynamos, motors, steam shovels, rollers, tractors, excavators, locomotives, drills and all other important machinery should be charged every day that they are located on the job and credit should be given for all services performed by them. These records show the efficiency of equipment or the loss through idle or waiting time and breakdowns.

Total cost of all important work and any important parts of it should be plotted on cross-section paper with the cost units measured vertically and the time measured horizontally, thus showing the actual cost from day to day by a full line above or below or intersecting the horizontal line, which should represent the estimated cost.

SEWERS AND WATER WORKS CONSTRUCTION

Sewer work and water works construction costs should be kept in a similar manner, itemized to suit the different conditions. Some of the items common to both will be city permits, safeguarding and diverting traffic, removing and replacing pavements, removing or reconstructing or safeguarding existing pipes, conduits and the like, excavating, trench sheeting, trench bracing, pumping, blasting and removing spoil, preparing sub-grades, building foundations, testing the line, backfilling, installation of derricks, operation of derricks, moving derricks, laying, shifting and removing industrial track, superintendence, inspection and miscellaneous.

In addition, the work for concrete sewer construction includes hauling, unloading, storing cement, aggregate, and sand; installing concrete mixer, operating mixer, delivering concrete, building forms, moving, cleaning and repairing forms, depositing concrete, rebuilding curbs, sidewalks, foundations, manholes, various other items and miscellaneous.

For laying water pipes, delivery of pipes, installation of derricks, hauling pipes, assembling

pipes, preparing and pouring joints, testing pipes, other items and miscellaneous.

KEY NUMBERS

In order to simplify the records and save time the classification should be keyed with a system of letters and numbers that will automatically indicate the characters of the items. For instance, all labor may be classified L, all equipment E, supervision S, materials M, supplies Su, and so on, with a few extras reserved for additional developments. Each division, such as surveying, paving, hauling, trenching, pumping, concreting, pipe driving and the like should have a series of ten numbers or more, as from 1 to 10, from 10 to 20, 20 to 50, and so on. For instance, if grading is from 1 to 10, rock excavation may be 1, boulders 2, dry earth excavation 3, mud excavation 4, hauling 5, backfill 6, and miscellaneous 9. Miscellaneous should always be added to every set to provide for things not easily classified.

Excavation may be again subdivided and each final item follow a decimal point so that 1.1 might be stripping, 1.2 drilling, 1.3 explosives, 1.4 blasting, 1.5 mucking, 1.6 rock drilling, 1.7 sledging, 1.8 loading, 1.9 miscellaneous. Care should be taken not to sub-divide different items too minutely, thus producing elaborate and complicated records that are costly to maintain and perplexing to handle.

Whatever system is adopted should be complete and accurate, positive and simple, without repetition or ambiguity, flexible to the different and changing conditions and to allow for more or less detail. It should be available daily for inspection, for purposes of comparison, revision, it should be inexpensive and it should be keyed with the regular time-keeper's and accounting records. Distributing of time should be such that the total time and cost of labor should check exactly with the sums for different operations.

EXPLANATORY AND DESCRIPTIVE

The cost account of any given piece of work should be accompanied by a very complete and concise description of the work and its condition describing the principal features, location, requirements, difficulties, methods, plans and equipment giving important facts such as the character of the rock, depth of excavation, length of haul, amount of traffic, character of labor, delivery of material and supplies, character of machinery and equipment and all other features that influence the methods and efficiency of the work and the character of operations for increase or decrease in cost.

Both the estimated and final actual quantities of cost and time should be given. These data should be accompanied by a diary containing entries for the amount and character of work, the working forces, the operation of machinery and inspection of materials, progress made, weather conditions and developments for each day. Special pains should be taken to note any deviation from specifications or contract and any agreements made or directions received from the engineer, architect or owner. These should be initialed by the official giving them, especially if it is necessary to act on them before formal written notice is received.

IMMEDIATE AVAILABILITY

Unit costs, costs of structure and total costs, actual and estimated, should be prepared daily and put in the record book, plotted on diagrams, and given to the superintendent so that the condition of the job may be instantly evident by inspection and so that excessive costs or delays can be noted and remedied immediately. Both records and diagrams will also show the relative progress of different portions of the work and the men and equipment that are available for shifting from point to point to equalize the work or to expedite it in case of emergency. Record cards for each foreman should be headed with the classification letter and general number columns for the different entries and lines for the details of operations corresponding to the units and decimals. All cards should have a line for miscellaneous work and every unclassified item must be fully described.

The Staten Island Tunnel

A bill has been passed by the New York Legislature, signed by the Mayor of New York City and now awaits the expected signature of the Governor of the state, to authorize the construction, by the City of New York, at its own cost, of a freight and passenger tunnel connecting the borough of Brooklyn and Richmond.

An appropriation has been made providing for the surveys and borings on two lines approximately from 65th street to St. George, and from 85th street, Brooklyn, to Rosebank, Staten Island, and if the bill becomes law, the preparation of design, specifications, and award of contract are expected to follow promptly. The bill authorizes the cities to construct the tunnel and lease it for operation to some party determined by the Board of Estimate.

This tunnel project is entirely separate and distinct from that long under consideration by the Public Service Commission, whose engineers are studying four alternate routes for tunnels to Staten Island and have recently made an appropriation of $50,000 for soundings and explorations.

Refuse Disposal in Passaic

(*Continued from Page* 369)

The city owns one 4.5-ton Four-Wheel Drive (F. W. D.) tractor. It will still use its own horses in the block collection of the garbage and ashes, etc.

All expenditures for collection and incineration will be paid from the general treasury, no direct charges being made for collection. Pails and ash cans are set out on the curbs by the householders and returned by them, and this practice will be continued. The total yearly cost of the collection has averaged, during the past five years, $37,750 for labor and teams. Labor on the dumps has averaged $1,000 a year.

Recent Legal Decisions

CONSTRUCTIVE NOTICE TO CITY AUTHORITIES OF DEFECT IN STREET FOR JURY

The general rule is well established that the facts and circumstances of each case must determine whether constructive notice of a defect in a street is to be attributed to the municipal authorities, and ordinarily this is a question for the jury. There are many elements which may properly be considered by the jury in passing upon this question. No definite rule as to the length of time a defect must have existed to furnish notice to the municipal authorities can be fixed by the court, and whether notice shall be imputed to the city authorities is ordinarily a question for the jury to determine from the length of time the defect has existed, the nature or character thereof, the publicity of the place where it exists, the amount of travel over the street, and any other facts or circumstances in evidence which tend to show notoriety, and from which they may conclude that by the exercise of ordinary and reasonable care and diligence the defect should have been discovered by the corporate authorities. In an action for damages for injuries caused by being thrown from a cart when the horse drawing it stepped into a hole in a bridge caused by a broken plank, the question of constructive notice was held for the jury. City of Greenville v. Middleton, Mississippi Supreme Court, 86 So. 804.

VALIDITY AND SCOPE OF MUNICIPAL DAY-LIGHT SAVING ORDINANCE

The Ohio Supreme Court holds, State ex rel. Cist v. City of Cincinnati, 129 N. E. 595, that an ordinance adopted by the electors providing that the standard of time for the regulation of purely municipal affairs shall be from the last Sunday in April to the last Sunday in September that of the seventy-fifth meridian of longitude west of Greenwich and from the last Sunday of September to the last Sunday of April one hour later, though in conflict with sections 5979 and 5980 of Ohio General Code, is authorized by Section 3, art. 18, commonly known as the home rule amendment to the Constitution. The ordinance requires only that the purely municipal affairs of the city should be regulated by the standard of time thus adopted. It purports only to prescribe a standard of time which shall apply to required acts of any board or officer of the municipality. The standard of time prescribed by the law of the state would govern and control as to all matters except those having to do solely with local governmental action and procedure.

CITY'S FAILURE TO FOLLOW STATUTORY PROCEDURE MAKES ASSESSMENT UNENFORCEABLE

The Florida Supreme Court holds, Carr v. City of Kissimee, 86 So. 699, that when the method and procedure for the enforcement of a lien for sidewalk construction is prescribed in the act authorizing the improvements, the city is bound to follow the method and procedure prescribed, and the failure to do so makes an assessment for such tax unenforceable.

WHAT IS COVERED BY THE TERM "LOCAL IMPROVEMENT"

Holding that an ornamental street lighting system is a local improvement which may be paid for by the levy of a special assessment, the Illinois Supreme Court says, City of Springfield v. Springfield Consol. Ry. Co., 129 N. E. 580, that the only essential elements of a local improvement are those which the term itself implies, viz., that it shall benefit the property on which the cost is assessed in a manner local in its nature, and not enjoyed by property generally in the city. So it was held in Northwestern University v. Village of Wilmette, 230 Ill. 80, 82 N. E. 615, that whether or not the improvement will be a benefit to all the property in the village is not the test. If the improvement will enhance specially the property adjacent to which it is made, the improvement is a local improvement. It has been uniformly held in Illinois that, although the construction of a general system of water works for fire protection and general use is not a local improvement, the laying of water mains for the distribution of water along a particular street for the use of residents is a local improvement which may be paid for by special assessment. In Ewart v. Village of Western Springs, 180 Ill. 318, 54 N. E. 478, the same doctrine was applied to the construction of a plant and system for lighting the streets by electric light, including the power house, generator engine, electric conductors and lamps and necessary appurtenances. After a consideration of the cases in regard to the construction of water works by special assessment, it was held that, so far as the plant for lighting the streets by electricity included the power house and electric generator engine, it might be regarded as an improvement of general utility which could not be constructed by special assessment, but that the poles, wires and lamps which are the means of furnishing the necessary light for the protection of the property of citizens constituted a local improvement.

INCREASE OF HYDRANTS RATES NOTWITHSTANDING FRANCHISE FIXING RATES

The Indiana Supreme Court holds, City of Washington, Ind., v. Public Service Commission, 129 N. E. 401, that the revision of the contract price at which water should be furnished to a city for use in extinguishing fires, under a franchise ordinance fixing the rate to be paid, is as completely within the rate-making power of the state as is a revision of the rates to be charged private consumers. To whatever extent, if at all, the power of the state to increase rates might be limited as against the city by reason of such a franchise contract, it is obvious that the rates charged other consumers would have to be increased in proportion if the water company were to be given the income which the law allows it to earn.

NEWS OF THE SOCIETIES

Apr. 26—ROCHESTER ENGINEERING SOCIETY. Joint meeting with the ROCHESTER ROTARY CLUB.

May 2-4 — MISSISSIPPI VALLEY ASSOCIATION. 3d annual convention. New Orleans, La.

May 4-7 — NATIONAL FOREIGN TRADE CONVENTION. 8th convention. Cleveland, Ohio.

May 5 — BALTIMORE SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with the Engineers Club of Baltimore.

May 5 — ROCHESTER SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint dinner of the professional engineers of Rochester, Powers Hotel.

May 6 — VANCOUVER SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

May 9 — HARTFORD BRANCH, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Get-together dinner at City Club.

May 9-11 — AMERICAN ASSOCIATION OF ENGINEERS. 7th annual convention. Buffalo.

May 9-11 — NATIONAL CONFERENCE ON CITY PLANNING. Pittsburgh, Pa.

May 9-12 — SOUTHWEST WATER WORK ASSOCIATION, Shirwin Hotel Headquarters, Oklahoma City, Okla.

May 10-12 — CANADIAN GOOD ROADS ASSOCIATION. 8th annual convention. Halifax, Can. Secretary George A. McNamee, Montreal.

May 16-18—AMBASSADORS & MINISTERS OF WORLD TRADE. Conference under auspices of NATIONAL ASSOCIATION OF MANUFACTURERS. New York City.

May 17 — CLEVELAND SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual dinner.

May 17-19—NATIONAL FIREMEN'S ASSOCIATION. Twenty-third annual convention. Fort Wayne, Ind.

May 18—BIRMINGHAM SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Annual business meeting. Southern Club.

May 19—EASTERN NEW YORK SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Edison Club Hall, Schenectady.

May 19 — SAN FRANCISCO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

May 20 — AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, 370th meeting. Engineering Societies Building, New York City.

May 20 — PHILADELPHIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Annual dinner, Hotel Adelphia Roof.

May 21 — ATLANTA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with ATLANTA SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

May 23-26 — AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Spring meeting. Congress Hotel, Chicago.

May 31-June 3—NATIONAL ELECTRIC LIGHT ASSOCIATION. Pasadena, Cal.

June 15-17—LEAGUE OF MICHIGAN MUNICIPALITIES. Kalamazoo, Mich.

Oct. 11-14—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual Convention, Atlanta, Ga. Hotel Ansley. Secretary, James J. Mulcahey, Municipal Building, Denver, Colo.

Sept. 28 (10 days)—NEW YORK ELECTRICAL EXPOSITION. Seventy-first Regiment Armory, New York City.

Nov. 14-18—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

AMERICAN ENGINEERING COUNCIL

At the Philadelphia meeting, Herbert Hoover resigned as president, giving as his reasons the fact that American Engineering Council by its constitution was necessarily engaged in furthering national activities which involve legislation; and that he as a member of the executive branch of the government could not consistently direct such activity as an officer of American Engineering Council.

One of the most important matters before the council was the report of the Committee on Elimination of Waste in Industry. Shop managers will find in the report a method of measuring the relative standing of their organizations and will find positive suggestions as to improved methods. The questionnaire has fundamental value, because of the pertinent leading questions it asks concerning means of production and the other aspects of management.

The finding will indicate the major factors which contribute to waste and their relative weight. It will suggest those long-time programs such as standardization and stabilization which are larger than the action any one group can take for itself.

The finding will indicate how each form of waste has been reduced or eliminated in certain industries, citing the specific instances.

Standardization alone will account for immense savings and the elimination of very costly wastes. Stabilization of manufacturing will remove some of the most serious causes of labor unrest and go a long way toward inaugurating a regime of co-operation between management and men. These changes can only be accomplished by directed group action. The report of the executive secretary gave the results of a special study of the Employment Service. Plans for broadening the scope of the service were recommended and adopted.

Dealing with the licensing and registration of engineers, the report said that this had been a very active feature of the council's legislative program. The council does not believe that such legislation is necessary, but where such is to become a fact it is interested in seeing that the legislation passed is of such character as to be beneficial both to the public and the engineering profession.

Other matters discussed by the secretary were petitions of the council for the appointment of an engineer as Assistant Secretary of War, in which favorable action was not obtained, and for the appointment of an engineer to the Interstate Commerce Commission, which is still under consideration; a request from the engineers in the public health service for co-operation in legislation that will give them professional standing and closer relations with the government departments both in giving appropriate counsel and in obtaining information which in the form of a bulletin service is being sent out in increasing volume to engineers in member societies.

The report of the Public Affairs Committee was adopted. This report recommended continuance of the public works campaign, to promote which the organization of the National Public Works organization will be continued. The Committee on New York State Government Reorganization reported that an elaborate report has been submitted to Governor Miller and the Judiciary Committees of both houses of the legislature presenting the engineering point of view as to the making over of the state government. This report has been widely noticed in the press and is having substantial influence on the question of remoulding the state administrative system.

Three new member societies have joined the Federation since the last meeting. They are the Boston Society of Civil Engineers and the Engineering Societies of Milwaukee and Duluth. Other important additions to the Federation's swelling membership and influence are expected to be announced before July 1.

The dinner, April 16, arranged in honor of Mr. Hoover by the Engineers' Club of Philadelphia, representing more than 4,600 engineers in the Philadelphia district, was the culminating event of the meeting of the American Engineering Council of the Federated American Engineering Societies.

More than 600 attended the dinner, which was held at the Bellevue-Stratford Hotel. Many of the leading citizens of Philadelphia were present as well as members of American Engineering Council. Mr. Aertsen presided and the other speakers included Dean Dexter S. Kimball, whose subject was "The Federated American Engineering Societies"; George Wharton Pepper, Col. William A. Glasgow and John C. Trautwine, Jr., all of Philadelphia. Mr. Pepper, foremost lawyer and publicist, made a brilliant speech in which he asserted that Mr. Hoover was more than engineer and as such he was an example for the engineering profession. Mr. Pepper, whose remarks concluded the speechmaking, appealed for a broader engineering training and greater participation by the engineer in the affairs of the state. Mr. Trautwine's subject was "The Engineers of Philadelphia." Col. Glasgow, close friend and fellow-worker of Mr. Hoover in relief work abroad, paid a tribute to Hoover the Man. Love of country and fidelity to its institutions was urged by every speaker, all of whom said that the engineer was becoming one of the most powerful agencies of the state, socially, economically and politically.

Mr. Hoover's address emphasized the vital national need of government reorganization and outlined an increased sphere of activity for the department of commerce, of which he is now the head.

Dean Kimball's address was an elaborate and convincing answer to those who ask why engineers should join the federation.

Mr. Aertsen's address was a eulogy of the career of Herbert Hoover.

N. Y. STATE ASSEMBLY, AMERICAN ASSOCIATION OF ENGINEERS

At a meeting held on March 12 at Albany, N. Y., the New York State Assembly of the American Association of Engineers was organized to co-ordinate the activities of all the chapters and clubs of the A. A. E. in the state on state matters, and to co-operate with the state section of the Federated American Engineering Societies and other organizations.

The following officers were elected: President, S. J. Stone; first vice-president, A. M. Knowles; second vice-president, G. F. Scharbach; and secretary-treasurer, J. G. Brennan.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The spring meeting of the American Society of Mechanical Engineers will be held in Chicago on May 23-26 at the Congress Hotel. On May 21 an excursion jointly with the S. A. E. will be made to McCook Field, Dayton, and following the meeting on May 27-28 an excursion will be made to Rock Island Arsenal with the Army Ordnance Association.

Interesting recent discussions at section meetings were "The Development of Modern Industry," by Dean Dexter S. Kimball, of Cornell, at the Rochester meeting on April 11; "The Gas Fired Steam Plant of the San Joaquin Light & Power Co.," by A. T. Meidell, of that company, at the April 14 meeting of the San Francisco section; and others contemplated are those to be presented at the regional meeting in the South on April 22 by representatives of each section, when a visit is planned to Chickasaw plant for inspection of the shipyard and power plant; and the paper on "Hydro-Electric Power Plants" by C. G. Adsit, of the Georgia Railway & Power Co.

PROFESSIONAL ENGINEERS OF ALBERTA

At the annual meeting of the Association of Professional Engineers of Alberta, held in Edmonton on March 26, the following officers were elected. President, R. A. Brown; vice-president, G. W. Craig; councillors, L. B. Elliot, T. Schulte, B. L. Thorne, Prof. C. A. Robb and Prof. R. S. L. Wilson.

VERMONT SOCIETY OF ENGINEERS

At its annual meeting on March 9, the Vermont Society of Engineers was addressed by Governor James Hartness on the proposed affiliation of this society with the Federated American Engineering Societies, and by Alfred Patche on modern engineering in Syria. The following officers were elected: President, M. E. Carpenter; vice-president, G. R. Varnum; secretary, G. A. Reed; and treasurer, T. W. Dix.

KANSAS SECTION, AMERICAN SOCIETY OF CIVIL ENGINEERS

A Kansas City section of the American Society of Civil Engineers was recently organized with the following officers: President, Alexander Maitland; vice-presidents, John V. Hanna and Col. E. M. Stayton; director, Louis R. Ash; and secretary-treasurer, Henry C. Tammen.

ILLINOIS AND IOWA SECTIONS, AMERICAN WATER WORK ASSOCIATION

A joint meeting of the Illinois and Iowa sections of the American Water Works Association was held on March 23-24, at which five middle states were represented. Technical papers were presented and an excursion to Chicago pumping stations made. R. Edman Greenfield explained the term hydrogen-ion concentration; S. A. Greeley gave comparative operating data of the Evanston, East Chicago and Whiting rapid sand filters; Walter A. Shaw and C. M. Ross discussed the matter of fixing rates for public utilities by contract; F. H. Mathews discussed the grading of utilities from the layman standpoint; D. H. Maxwell discussed the geological difficulties of Bloomington, Ind., in finding a reservoir site that will hold water; and John Ericson showed that Chicago could not afford to filter its supply until it reduced its waste. All of these papers were most interesting.

The Illinois section elected the following officers: Chairman, John W. Alford; vice-chairman, Henry R. Ringness; treasurer, H. E. Keeler; and new trustee, Dr. A. M. Buswell.

LOUISIANA ENGINEERING SOCIETY

The regular meeting of the Louisiana Engineering Society was held on March 14 at 8 p. m. The technical exercises of the evening consisted of a paper entitled "The Financing of Road Construction," by Hon. Harry P. Gamble.

CONFERENCE OF IOWA ROAD OFFICIALS

The eighth annual conference of Iowa Road Officials was held at Ames, Ia., on March 23-24, inclusive. The program included numerous papers on road building, road assessments, contracting problems, highway bridges, transportation, pavements, road maintenance and other subjects of interest to road officials.

MASSACHUSETTS HIGHWAY ASSOCIATION

At the annual meeting of the Massachusetts Highway Association, held at Boston on February 24, the following officers were elected for the ensuing year: President, Henry V. Macksey; vice-president, Robert P. Marsh; secretary, John A. McCarthy; treasurer, Charles A. Brown; and directors, John A. Gaffey and Henry A. Spates.

NEW HAMPSHIRE GOOD ROADS ASSOCIATION

The regular quarterly meeting of the New Hampshire Good Roads Association was held at Concord on March 10, and was attended by about 75 members. Officers for the coming year were elected as follows: President, Harry L. Smith; and secretary-treasurer, Jerry Killory; first vice-president, C. M. Parks, and directors, Ovid F. Winslow and F. H. Colburn.

NEW YORK STATE ROAD BUILDERS' ASSOCIATION

The New York State Road Builders' Association held its annual election on March 18, at which the following officers were elected: President, John H. Gordon; vice-president, C. J. Hendrickson; and trustees, William G. Fox and Louis Mayersohn.

SOUTHERN PINE ASSOCIATION

The sixth annual meeting of the Southern Pine Association was held at the Grunewald Hotel, New Orleans, La., April 5 and 6.

In addition to the regular program many interesting exhibits were made and charts displayed, showing the work of the association, the use to which lumber and its by-products can be put, and the latest statistics and graphic charts showing economic conditions affecting the lumber industry.

The principal papers, addresses, discussions and reports included "What the Southern Pine Association Has Done for the Industry and the Public," report of Secretary-Manager J. E. Rhode. "The Contention of the Government," statement by Judge John H. Lucas, chief counsel, Southern Pine Association, Kansas City, Mo. "Trade Associations Essential to Successful Business," Judge L. C. Boyle, counsel, National Lumber Manufacturers' Association, Washington, D. C. "Governmental Control Stifling National Development," Mr. Chas. S. Keith, Kansas City, Mo., chairman, committee on economics, Southern Pine Association. "Engineering Problems Affecting the use of Southern Pine," Mr. Geo. E. Strehan, consulting engineer, Southern Pine Association, New York City. "Waste Prevention and Utilization," Mr. C. E. Paul, construction engineer, National Lumber Manufacturers' Association, Chicago, Ill.

PERSONALS

Longstreet, S. P., recently in charge of the Scranton district, Pennsylvania State Highway Department, has been appointed chief engineer of the Philadelphia district.

Swift, C. J., has been appointed highway engineer of Blue Earth Co., Minn.

Moore, E. F., has been appointed assistant chief engineer of the Sanitary District of Chicago.

Jenkins, Everett W., formerly with the engineering department of Worcester, Mass., has been appointed superintendent of streets of Quincy, Mass.

Allen, James, has been appointed supervisor of highways for the State of Washington.

Nicolett, P. M., has been appointed city engineer of Graham, Texas.

McElherne, J. C., formerly with the state highway commission at Rochester, has been appointed engineer of Rice county, Minn.

Preston, P. J., project manager of the U. S. Reclamation Service, Uncompahgre Project, Montrose, Colo., has been transferred to the Yuma Project, and Foster, L. J., has been appointed to his position.

McGill, R. D., is project engineer in charge of federal aid project No. 16, consisting of road construction on the Kimball-Harrisburg highway.

McCamy, C. C., has been appointed city engineer of Dalton, Ga.

Ford, E. Paul, has been appointed city engineer of East San Diego, Cal.

Eckart, N. A., formerly construction engineer of the Hetch Hetchy Water Supply, with headquarters at Groveland, Cal., has been appointed chief assistant city engineer under City Engineer M. M. O'Shaughnessy.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

QUALITY TANKS, BODIES AND HOISTS

The equipment manufactured by the Heil Co. includes a number of special steel truck bodies with and without dumping hoists, intended for various kinds of service and for general contractors for hauling purposes. There are several models with rear and side gates for handling coal. Standard bodies are from 4½ feet to 6 feet wide and from 9 to 12 feet long, and are made 3 inches wider at rear than in the front with the sides strengthened by flanges. They are equipped with single acting tail gate with 100 per cent manual control. Various models are made with square and with round corners and with straight or flared sides.

ASPHALT BODY WITH LAYER OR ASBESTOS BETWEEN INNER AND OUTER SHELLS

The bodies are provided with auxiliaries including double acting tail gate, mud guards, swinging partitions, wearing plate and four sizes of hydro-hoists that are mounted on the chassis frame in front of the rear axle and take power from the front propeller shaft or transmission amidships applied through universal joints to the pump drive. The hoist can be pumped up to develop a lifting power of more than 34,000 pounds and is provided with a safety device that insures the lowering of the body at a constant rate of speed.

There are also truck tanks for gasoline and other liquids that are furnished with can box, sills, can racks, piping and faucets mounted on the chassis.

Garbage bodies with capacities of 2, 3, 4 and 5 tons have the lower half of the bodies water tight and are furnished with or without covers. Those that are without covers are provided with loops so that a canvas can be tied over the top. Asphalt bodies made in 6 sizes with capacities of 2½ to 6 tons, also have the manual tail gate control operated by a lever at the driver's seat. They are made with asbestos 3 inches thick between inner and outer steel shells.

BROWING LOCOMOTIVE CRANES

Locomotive cranes manufactured by Victor R. Browning are of 7½-ton and 10-ton capacity and are mounted on standard gauge flat cars or on crawler traction.

Hoisting, rotating and traveling can be performed simultaneously. There are two main hoisting engines with drums driven by spur gearing and provided with band friction clutches actuated by a steam ram installed on the master gear. The boom is raised or lowered by gears and a worm wheel operated by a positive clutch.

The crawler crane can travel anywhere that motor power can go, irrespective of road or soil conditions and has a crawler belt composed of individual pads constructed of either armor plated wooden blocks, or entirely of steel, and so arranged that the driving power is equalized through the entire machine. The 40-foot boom operates either a ¾ or a 1¼-yard bucket and can be replaced by a 20-foot steam shovel boom equipped with a 7/8-yard dipper and crowding engine, which can be operated at variable radii and dumped as high as 18 feet above floor level or 25 feet from the center of the machine.

With little change the crawler crane can also be easily converted into a ¾-yard drag-line excavator. The crawler can make very short turns, can travel equally well through mud, sand, or on rocky ground, and can surmount grades of 40 per cent without overloading the engine. The machines may be driven by steam, electric or gasoline power.

WHIP-TAP SAND AND GRAVEL SCREENS

Portable whip-tap screens manufactured by the W. S. Tyler Co. are recommended for road work because they produce to specifications at less cost than by any other means, thus saving freight and hauling, can be operated in winter, handle wet, dry or sticky material, and only require ten minutes for changing the screen.

PORTABLE WHIP-TAP SCREEN

The important principles involved are drum head screen tension, and continuous unchecked vibration. The screening surface being kept constantly alive secures maximum tonnage of thoroughly screened material.

JACK OF ALL EXCAVATORS

This machine, manufactured by Pawling & Harnischferger Company, has an adjustable 30-foot steel boom revolving on a steel platform supported by steel front wheels and rear caterpillar traction. It has a locomotive crane which has a lifting capacity of 15,200 pounds at 8-foot radius, and can be equipped with a Page or clamshell bucket for many kinds of excavation, loading and handling loose materials, or with a drag-line or orange peel bucket. It has a 40 h. p. gasoline motor, a drag-line pull of 9,500 pounds and a locomotive speed of 100 feet per minute and a swinging speed of 3 and 4/10 per minute. It can be shipped without dismantling and is operated by one man, not a licensed engineer.

WATERTIGHT GARBAGE BODY WITH ELECTRICALLY WELDED SEAMS

PUBLIC WORKS.

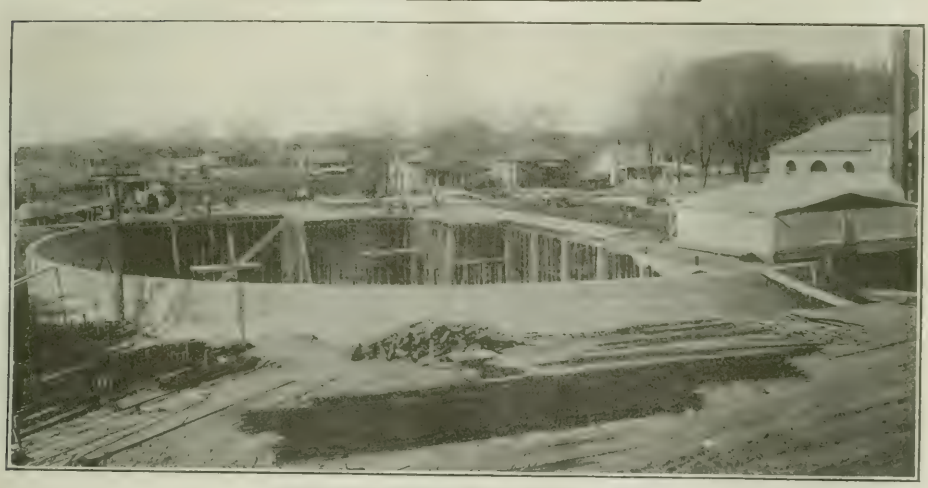
CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Municipal Journal and Engineer, Inc.
Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879

Vol. 50 MAY 7, 1921 No. 19

Large Reinforced Concrete Covered Reservoir

Vertical walls on limestone ledge as a bottom, with reinforced concrete slab roof, to be used for tennis courts. Walls poured continuously and slip forms used. Column forms used repeatedly.



RESERVOIR WITH ROOF PARTLY PLACED
At right, tent for covering new concrete in the rainy weather

A two-million-gallon concrete reservoir has recently been completed at Arkansas City, Kan., which embodies some interesting features of design and methods of construction.

The water supply of that city is obtained from wells equipped with motor-driven, deep-well type, vertical centrifugal pumps, located approximately 1¼ miles from the high-service pumping station, and is pumped through a twenty-inch wood-stave pipe line to the reservoir located near the main pumping station. The reservoir provides a reserve storage for use in case of interruption of power service or other emergency demands, and which allows the well pumps to operate at uniform steady rates.

The site decided upon as most available for the reservoir location was a low tract of ground that had been of a swampy nature and had been partially filled in with old refuse, brick, tin cans, street sweepings and rubbish. Test borings were made and the results indicated approximately an average of eight feet of old fill and original loam and two feet of water-bearing sand overlying a solid limestone stratum, requiring six feet of light sheeting to hold the lower banks. The ground water level was approximately four feet above the rock surface. The rock surface was fairly smooth and level, having a grade or dip of less than 8/10 of a per cent. Several faults or cracks, from ¼ inch to 1 inch wide, averaging about twenty feet apart and running at right angles to each other, were cleaned out and grouted full with a 1:2 cement mortar, and after chipping off some of the uneven places, the entire rock surface was

washed with a cement grouting and used as a floor.

The reservoir is circular, of reinforced concrete, ring tension type, 156 feet inside diameter and designed for a depth of fourteen feet of water. It is covered with a five-inch reinforced concrete roof slab carried by 10 x 15-inch beams spaced twelve feet centers each way and supported by 10 x 10-inch concrete columns. The roof was divided by expansion joints into slabs twenty-four feet square and rests freely upon the beams. The slab was designed for 90 pounds live load in excess of the dead load. The entire roof was given a slope of eight inches from the center to the outside walls.

A trench was excavated in the rock to provide a sub-footing under the walls and to secure a good bond to prevent leakage. In order to provide for the indeterminate cantilever stresses, the sub-footing was finished off smooth and an asphalt expansion joint was provided between the sub-footing and the wall footing proper.

The wall was made fourteen inches thick without taper toward top, in order to facilitate the use of slip forms. The horizontal steel was placed in two rows and held in place by vertical standards, six feet centers, built up of 3-inch channels, to which short strap-steel lugs, with notches for holding the bars, were riveted at the required intervals. The channel standards facilitated the placing of the steel and insured the proper spacing and prevented the displacing of the bars during the pouring of the concrete. The standards were accurately centered and held in place by braces until the footing had been poured and then the standards were sufficiently rigid to be self-supporting.

A system of slip forms four feet high and in sections twelve feet long were made up of 1-inch shiplap and assembled and centered in place. The forms were filled within six inches of the top and were then raised by means of the ordinary slip form jack operating on a one-inch jack rod. The jack rods were spaced approximately eight feet centers and two men made the circuit twice an hour raising the form about one inch each time. The one-inch jack rods were cut off at the top of the wall when the pouring of concrete had been completed.

The wall concrete was run continuously, requiring a total time of eighty hours for completion. There were three eight-hour shifts, each consisting of ten laborers and a foreman mixing and placing concrete, three men placing and wiring steel, two men operating form jacks and two carpenters shifting runways and miscellaneous work. Two mixers were placed on opposite sides but owing to shortage of labor only one mixer was in operation at a time, the crew changing from one mixer to the other every hour. Concrete was conveyed from mixers to wall in wheelbarrows on board runs.

This method of construction eliminated all construction joints and gave a smooth finished surface which under water test showed practically no leakage, and only slight leakage was found through the small fissures in the rock bottom. Column footings were placed and their tops carefully graded from center to walls to conform to roof slope, so that all the column forms were of same length, simplifying the construction and placing of forms. A part of the roof was poured during freezing temperatures, the work being protected by using a canvas tent covering and heating with steam coils, heating sand and water for mixing, and covering the completed work with paper and straw before removing the tent to the next section.

The location of the reservoir being on public park property, the top slab was given a float and trowel finish, and the manhole openings and ventilators were so placed that two tennis courts could be laid out on top of the reservoir. Pipe couplings or sockets were set in the roof slab for installing net posts and also around the wall for fencing the entire area.

The principal quantities in the construction were 7,162 cubic yards of earth excavation; 1,038 cubic yards of concrete; 71.7 tons of reinforcing steel and 4.2 tons of channels and miscellaneous.

The total cost of the completed reservoir was $52,887.21. The reservoir was designed by Burns & McDonnell Engineering Company, of Kansas City, and constructed by Ray & Son, contractors, of Baxter Springs, Kan.—and the work was inspected and supervised by Charles W. Lusk, city engineer of Arkansas City.

The Effect of Alkali Upon Concrete*

By S. H. McCrory†

Decomposition caused and explanations of it offered. No method known of preventing such deterioration, but impermeability retards it. Recommendations as to aggregate, proportioning and placing of concrete.

The attention of engineers has been drawn recently to a number of cases in which concrete structures have partially or totally failed, due to the action of alkali upon the concrete. The extent and severity of this action has caused considerable concern among engineers intrusted with the design or construction of concrete structures in regions where the soils and ground waters are alkaline. Such conditions generally are found in the arid and semi-arid regions of the United States. Recently, however, a number of failures of concrete drain tile exposed to the action of alkaline soils and ground waters have occurred in the southwestern part of Minnesota. The mean annual rainfall in this region varies from 25 to 30 inches per annum and yet strong concentrations of alkalies are found.

*From "Public Roads," the official organ of the Bureau of Public Roads.

†Chief of Drainage Investigations, Bureau of Public Roads.

The alkalis present in the soils are the salts of various metals. The more common are sodium chloride ($NaCl$), sodium sulphate (Na_2SO_4), magnesium sulphate ($MgSO_4$), calcium sulphate ($CaSO_4$), calcium carbonate ($CaCO_3$), and calcium bicarbonate ($CaHCO_3$). Other salts are also frequently present. Typical analyses of alkalis from the surface of the ground in various locations are shown in Table No. 1, which is taken from Technological Paper No. 95, Bureau of Standards.

Table No. 1 Typical analyses of alkalis from various localities

Constituents of soluble solids in per cent.

Location.	Na_2	K	Ca	Mg	Cl	SO_4
Garland, Wyo.	[illegible]	0.5	0.4	0.1	Trace	68.0
Fort Shaw, Mont.	20.2	.2	2.3	1.1	1.1	69.1
Sunnyside, Wash.	20.4	.2	.6	.6	10.0	64.7
Yuma, Ariz.	24.7	.5	7.1		52.6	15.1
Roswell N. Mex.	10.5	2.3	16.4	4.9	22.0	47.0
Montrose, Colo.	9.1	...	2.1	26.7	Trace.	61.8
Grand Junction, Colo.	28.1		.2	0.9	1.1	4.8
Huntington, Utah	25.6	.6	2.3	2.5	1	[illegible]

In Table No. 2 are presented a number of analyses of drain and soil water from various locations:

In both tables the SO_4 content is high for all localities except Yuma and Roswell. The alkali at Roswell, though low in SO_4, nevertheless

Table No. 2 Analyses of drain and soil water from various localities

Per cent of SO_4 in solids

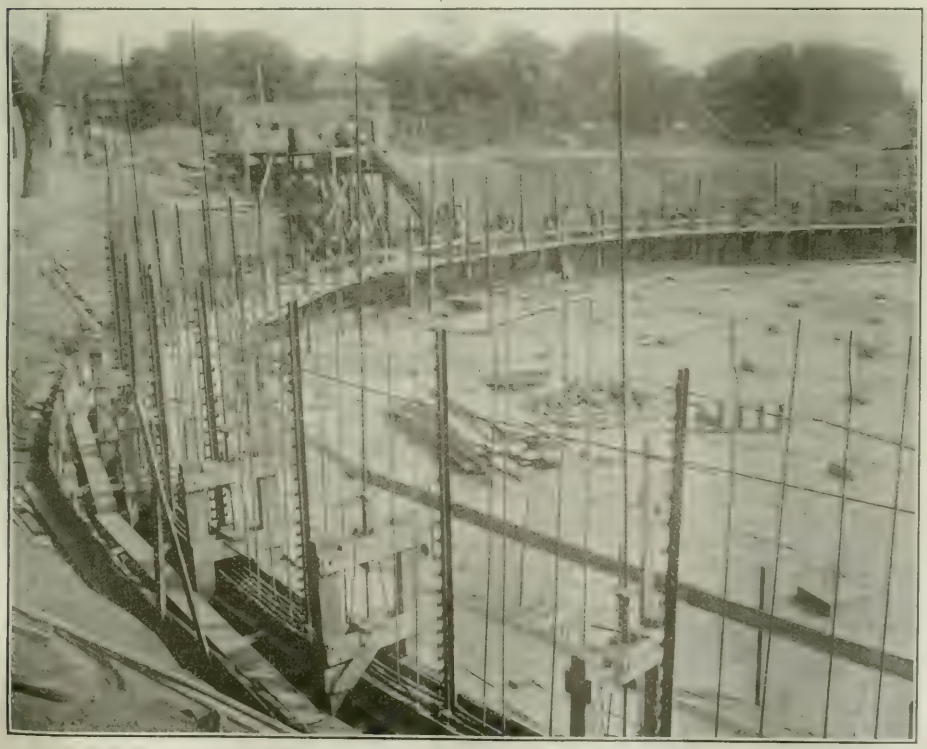
Location.	Parts per million in water.	Percentage composition of solids.							
		Na_2	Ca	Mg	Cl	SO_4			
Garland, Wyo.	[illegible]	[illegible]	14.3	7.7	[illegible]	46.6			
Fort Shaw, Mont.	2	[illegible]	0.6	1.5	1.6	[illegible]			
Sunnyside, Wash.	4	24.7	1.5	11.2	2.1	[illegible]			
Yuma, Ariz.	12	[illegible]	10.7	1.2	13.4	1.2			
Roswell, N. Mex.	36	2.0	1.4	1.7	27.1	[illegible]			
Montrose, Colo.	4	1.2	15.8	2.4	[illegible]				
Grand Junction, Colo.	58	2.0	1.1	1.4	1.7	2.7	1.1	1.7	
Huntington, Utah	6	1	2.1	1.1	1	[illegible]			
Lyon, Carson, Nev.	[illegible]	3.5	2.2	2.3	[illegible]	2		1.2	
Lyon, Carson, Nev.	3.6	2.9	3.6	1.5	1	4.5	1	1	

[illegible] Soil water

causes serious injury to concrete that is exposed to it. It will be noted in these tables that usually some one of the constituents will predominate in a given section. Along the seacoast the predominating salt is usually sodium chloride (NaCl) or common salt, while in the Great Plains regions the sulphate type predominates.

THE ACTION OF THE ALKALI

When concrete is exposed to the action of solutions of these salts the lime of the cement combines with the salts to form other compounds. The chemical action is accompanied by a change



CONSTRUCTION DETAILS OF ARKANSAS CITY RESERVOIR

Shows method of supporting reinforcing bars and of raising slip forms. Concrete mixer in background. Wheelbarrow runway inside of forms.

in the physical condition of the concrete. The first indication of the action of the alkali that can be noted is the presence of minute crystals of various salts in the concrete. These can be detected if fresh fractures are examined. As the action progresses a chalky band forms in the concrete near the surface which is in contact with the soil. In drain tile this band usually forms at first about three-eighths of an inch beneath the outer surface. As the action progresses the band widens and assumes a white chalky appearance, much like lime mortar. As this chalky band widens, swelling and cracking of the concrete become apparent. In one case of a 24-inch concrete tile which had been placed in an 11-foot cut and exposed for about four years to the action of soil water containing 2.22 per cent of alkali, of which 49 per cent was SO_3, the swelling and cracking were very noticeable.

Most concrete structures are alternately dry and wet. The alternate drying and wetting has a tendency to impair the concrete. When salts are present this deterioration is intensified, due to their crystallizing in the concrete when it dries. In most localities there is added to this action the disrupting effect caused by alternate freezing and thawing of the moisture in the concrete. While the effect of each of these factors on the concrete may be relatively very small, they combine to make the concrete more porous and thus to admit more readily the salt-bearing solutions to intimate contact with the cementing material. Some experimentors have thought that the disintegration of concrete was caused by the formation of substances having a large molecular volume and that this occurs when the sulphate salts of magnesium and sodium are present. The chemical reactions which take place are not fully understood, but it seems that failure is due to chemical rather than physical action.

A number of samples of concrete that have been subjected to the action of strong solutions of sulphates have been examined, and in each case it is found that a considerable amount of the cement has been removed. Microscopic examinations indicate that the cementing material has been replaced by other compounds of little cementing value, such as gypsum and the carbonates of lime and magnesia.

NO PROOF AGAINST ALKALI FOUND

Many investigators have tried to find a method of making concrete that would be proof against the action of salts, but so far none has been successful. It has been shown, however, that the more impermeable the concrete, the more strongly resistant it is to the action of the salts. The strength of concrete does not seem to have a definite relation to the action of salts upon it as frequently, in testing concrete tile, specimens are found in which the concrete is seriously disintegrated but which shows little loss of strength when tested. In general, it may be said that all available data indicate that in sulphate waters the extent and rapidity of failure depend upon the concentration of the salts in the soil and soil water to which the concrete is exposed. Concentrations may occur which will cause the disintegration of the most impermeable concrete that can be made by methods now employed. Various experiments and investigations indicate, however, that when exposed to solutions of equal strength the richest mix will prove most resistant. Concretes with high absorption are especially susceptible to attack.

TO SECURE MOST IMPERMEABLE CONCRETE

If it is known that concrete is to be exposed to the action of alkalis, great care should be used in grading the materials so as to secure the densest and most impermeable concrete possible. If a choice is possible, the sand and coarse aggregate should be of such a character that they will not be affected by the action of the salts. Limestones, dolomites and sandstones should be avoided. In placing the concrete great care should be exercised to secure the best possible workmanship. The concrete, after being placed in the forms, should be well spaded and tamped, and extra precautions should be taken to prevent the formation of a porous layer at the close of each day's work. The foundation should, if possible, be thoroughly drained either by open ditches or underdrains. If this cannot be done, it might be helpful to make the backfill next to the concrete of coarse gravel, so that when the water table drops, capillary action will not bring moisture to the concrete through the soil. When it is necessary to use sand, gravel or other aggregates that are known to contain alkali salts in considerable amounts, they should be thoroughly washed before they are placed in the concrete, even if alkaline water has to be used.

Various preparations have been used in an attempt to make concrete impervious to moisture. Cement grout, tar coating, ferrous sulphate and various waterproofing paints have been tried, but so far none of these seems to have been successful. Any value they have is of a temporary character. The use of intregal waterproofing compounds or hydrated lime might be of value in securing a more impermeable concrete.

Where high concentrations of salts are known to exist, the importance of careful grading and rich mixture, so as to secure the densest and most impermeable concrete possible, cannot be overestimated. Under such conditions cement, sand, aggregate and mixing water should be the best obtainable. The fabrication of the concrete should be done by experienced workmen, and when it is placed in the forms it should be done in such manner that the structure will be truly monolithic. The foundation should be provided with the best drainage obtainable. If these precautions are followed structures can be built which will be strongly resistant to the action of alkali. There is no assurance, however, that concrete of even the highest impermeability that can be obtained under present methods of manufacture will withstand the stronger concentrations of alkali of the sulphate type.

Highway Bridge Construction—I

Unloading and Hauling Steel Girder Spans

Simple methods using ordinary plant and general contractors' equipment

Highway bridge spans up to 50 or even 75 feet in length can usually be made advantageously with plate girders, which are not only simple to fabricate, but are easily transported and can be quickly erected and put in service. Their construction is so simple that mistakes in it are minimum and the principal consideration for their installation is the selection of the most suitable method of handling the heavy concentrated weights, which may vary from 5 to 50 tons.

These bridges are always built in special shops designed, equipped and operated for bridge construction and are usually shipped to or near the bridge site by railroad on flat cars or gondola cars. Sometimes the contract provides for the erection of the spans, ready for service, by the fabricator, in which case it is only necessary for the general contractor or the engineer to provide the sub-structure ready to receive the superstructure and to take care of the traffic until the new bridge is ready to be opened.

When the highway contractors or officials erect the girders it is usually necessary to unload them from the railroad cars and transfer them to the bridge site. If the steel is delivered in a large freight yard there are usually at hand ample facilities for unloading it from the cars and reloading it on trucks by means of derricks, travelers, gantries, locomotive cranes or other power devices. If it is delivered at a country siding these facilities may be absent and the contractor or official may have to provide the entire unloading equipment.

For spans of 30 feet or less, the girders are usually laid with their webs horizontal on the floor of the car. When they are too long for the car, girders up to 35 or possibly 40 feet long are usually loaded with one end on the floor of the car and the other end raised and projecting beyond the opposite end of the car, the girder webs being vertical and braced in position. Longer girders must be loaded on two flat cars, braced together with the webs in vertical position. The braces and small pieces are loaded loose, in bundles or boxes packed on the car and easily unloaded by hand.

DERRICKS AND GANTRIES

If the contractor has a considerable amount of freight to receive at the point where the girders are delivered, it will probably pay him to install a stiff-leg derrick with a 50-foot boom of 5 or 10 tons capacity, which will suffice for handling even a 30-ton girder if necessary, by restricting the radius and by arranging to lift only one end of the girder at once, thus increasing the capacity of the derrick while reducing the load.

If derricks are not available it may sometimes be convenient to install hoisting tackle and a hand windlass or crab on a gantry or a pair of gantries spanning the track by which the girder can be lifted from the car and lowered to the track or to a truck alongside. Girders can also be handled by tackle and windlass on a gin pole or on a pair of gin poles, which are simple masts carefully placed on foot blocks, well guyed at the top and inclined so as to slightly overhang the load. These can be improvised from any suitable piece of timber and are easily erected and removed.

JACKING, CRIBBING AND SKIDDING

In the absence of all of these appliances the girders can be unloaded and reloaded by jacking and cribbing, using one or more of the most powerful jack screws available, and a sufficient quantity of short timber of any convenient dimension; railroad ties answer the purpose if nothing better is available. If the girder can be transferred directly from the railroad car to the truck by which it is to be hauled to the site, a skid, consisting of a rail or I-beam, properly supported, will be placed transverse to it at each end and supported on the railroad car and at the proper lower elevation at or adjacent to the truck or trucks. The girder should, if necessary, be jacked up sufficiently to permit the insertion of the ends of the skids under it, and to permit the withdrawal of the blocks on which it was supported, and then lowered to rest on the skids, on which it can easily be pushed transversely to a position over the trucks, or jacked up on cribbing if necessary, the skids removed and the girder jacked down to bearing on the trucks. The upper surfaces of the skids should be greased and if they are inclined much from the horizontal snubbing ropes or preventor tackle must be attached to both ends of the girder to hold it back and prevent it from slipping down the incline except as the rope is paid out.

It is possible to lift the girder with a single jack placed at each end alternately, but it is much better and much more convenient to have two jacks at each end simultaneously if possible, but successively if necessary. A short transverse beam can then be placed under the end of the girder and one jack placed at each end of it, giving greater stability to the girder. Jacks, of course, can be used in multiple by providing for suitable arrangement and balance.

ROCKING AND TURNING

If the girder is very heavy it is possible to raise or lower it slowly with the application of very moderate power by providing it with two bear-

ings only a few feet apart and on opposite sides of the center and then with jacks under each end alternately raising first one and then the other, so that the support comes on first one and then the other of the two bearings, allowing the released bearing to be raised or lowered every time.

A girder can be raised clear of the car, a suitable transverse beam or girder inserted under it at each end and supported clear of the car, the girder lowered to bearing on the beams and the car removed; after which the girder is jacked down to the ground, to low level skids or to a car or wagon placed under the beams.

When a girder is being unloaded or loaded for trucking, it is often more convenient to roll it over so that the web will be horizontal or to place it right side up, or to swing it end for end so that it will arrive at the site in the proper relative position. In rolling it over, timbers should be provided to receive it and allow it to descend gradually without slipping back. To turn it end for end it should be supported at the center of gravity on upper and lower loose steel plates with the horizontal contact surfaces well greased, which will enable the girder to be revolved 180 degrees without difficulty.

HAULING

Short girders weighing not more than 5 tons can generally be hauled on an ordinary heavy truck with a long reach, from the axles of which they may be suspended by chains at each end.

Longer and heavier girders are usually transported on special trucks, or on a truck and trailer; or by special pairs of very heavy broad-tired wheels, special axles, and bolsters on which the girder can be loaded directly or from which it can be suspended.

The girders can be hauled by from one to a dozen teams, or when very heavy, preferably by tractors. Care must be exercised in passing through very narrow or crowded streets, in turning corners and on poor roads and steep grades. Great care should be taken to avoid injuring pavements, manhole covers, and bridges, with very heavy girders, which may require to have long planks laid under the wheels or the bridges shored up before the girder passes over them.

If no other means of transportation are available, girders can be moved on rollers on very level hard road or on sectional tracks taken up in the rear and laid down in front as the girder progresses. Pieces of heavy pipe or sticks of long hard wood may be used for loose live rollers put under the front end of the girder and working out at the rear end as the girder advances; or rollers or wheels in small frames may be placed under the girder, moving along with it on a track composed of timbers, rails or I-beams laid on the surface of the ground or on crib work.

Snubbing ropes or preventor tackles must be used when the girder is going down hill, and on the level or upgrade it can be hauled by teams or tractors, assisted, if necessary, by tackles attached to the girder and to trees or dead men in advance and operated by men, teams, windlasses or by a hoisting engine installed on the girder.

Wheels or rollers can be placed under a girder, or sometimes even under a pair of girders and bracing forming a completed span, and a steam roller, borrowed from the paving equipment, can serve as a tractor to haul it at slow speed over smooth hard roads. In some cases it might be possible to use two rollers, one at each end of the girder and suspend the girder between them, thus carrying it clear of the ground.

New Bedford Water Works Notes

In its report for the year 1920 the water board of New Bedford, Mass., records that during the year a little over 5½ miles of water mains were added to the system, which is nearly twice the amount laid during the previous year. Early in the season much difficulty was encountered in obtaining labor for trench work and to remedy this the board purchased a Bucyrus steam shovel with a long dipper-handle for trench work. The shovel was received on October 11 and its use during the remainder of the year "has resulted in a saving in the cost of excavation for pipe laying, and at the same time solving the problem of the shortage of labor."

"A ¾-ton Atlas truck has been purchased and equipped with a device for operating gates in the main pipe line by power directly from the engine of the truck. This truck is held in readiness to respond to emergency calls and results in great saving of time in shutting off burst main pipes and hydrants, thus reducing the loss of water from these leaks and thereby also reducing the damage to surrounding property."

"It has always been the custom of this department since the beginning of the works, to use lead for making joints in cast iron pipe. During the past fifteen years various less expensive substitutes for lead for this purpose have been placed on the market and widely advertised in the water works field. The oldest of these is known as 'Leadite.' Some years ago a few joints were made here with two of these compounds, viz.: Leadite and Lead Hydrotite, and both appear to be giving good results here. The use of either of these substitutes results in considerable saving over the cost of lead joints.

"Some cities and water companies have been using them for several years with satisfactory results and considerable saving of labor, as well as in the cost of materials.

"Early in the season, extensive experiments were made to determine the relative value of these two compounds. As a result, Leadite was adopted, and has been used for the greater part of the work laid this year. Its use has resulted in a saving of from 70 to 80 per cent in the cost of material besides a considerable saving in the cost of labor, as the leadite does not need to be caulked after it is poured into the joint, as is necessary with lead.

"Additional saving in the cost of joints has been effected by the use of braided jute yarn in the place of ordinary loose jute for the backing of the joint."

PUBLIC WORKS

Published Weekly
by
Municipal Journal and Engineer, Inc
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba....$3.00 per year
All other countries .....$4.00 per year

Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

CONTENTS

LARGE REINFORCED CONCRETE COVERED RESERVOIR—Illustrated 389

THE EFFECT OF ALKALI UPON CONCRETE—By S. H. McCrory—Illustrated 390

HIGHWAY BRIDGE CONSTRUCTION 393

New Bedford Water Works Notes 394

EDITORIAL NOTES 395
Form Economy for Concrete Reservoirs—Constructing Short Highway Spans—Traffic Justification for Highway Construction

Why Highway Construction Prices Are High 396

Undesirable Immigration Legislation 397

Building Construction Outlook 397

Recent Highway Prices 397

WORK DONE DURING 1920 AND CONTEMPLATED DURING 1921—Table 398

Form Economy for Concrete Reservoirs

One of the most interesting features in connection with the concrete reservoir described in this issue is the attention given to securing maximum economy in forms. In practically all structural work of concrete the forms required add very materially to the cost, the cost of constructing, placing and removing these frequently being considerably more than that of the concrete itself. In this reservoir the engineers used slip forms for the walls, so that one set of forms 4 feet high was used for the entire height of the reservoir and as the tank was raised were moved upward gradually at very little expense. In the construction of the concrete columns, also, economy of forms was considered, in that these were arranged so that the same forms could be used throughout, although the columns themselves were of somewhat different total height to provide for an 8-inch pitch to the roof which they support. This repeated use of forms was secured by building the low footings separate from the columns and so adjusting the elevations of their tops as to bring them at a uniform distance below the roof, thus causing the remaining part of the columns to be the same height in every case.

Other notable features in this reservoir were the fact that the concrete walls were poured in one continuous operation, this insuring absolute freedom from construction joints, while the raising of the slip forms inch by inch eliminated any appearance of such joints. Also, instead of being covered with the customary groined roof, the roof of this reservoir was constructed with a reinforced concrete slab carried by reinforced beams. The top of the roof was finished off smooth and level, except for the pitch of 8 inches in 78 feet, and is used for lawn tennis courts.

Constructing Short Highway Spans

"Short Span Highway Bridges," published in PUBLIC WORKS, April 16-23, reviews the subject in a way indicating the general scope and enumerating the principal features of ordinary road bridges, which are built every year by the thousands by the cities, towns, counties and highway departments of the United States. In the aggregate they constitute much the largest proportion of highway structures and represent a corresponding amount of the total cost of building bridges other than railroad bridges. The principal considerations which should govern the location, strength, size, character and materials of the ordinary suburban or county bridge were there reviewed to show the essentials required for the final preparation of plans and the execution of the work.

It is proposed to follow this article with a series of articles describing and illustrating some of the difficulties and requirements of the construction work, enumerating most of the ordinary methods, operations, and plans that are available for this class of work under normal conditions; explaining some of the principal difficulties likely to be encountered and the methods of overcoming them; and describing processes and equipment that have been developed for this class of work. They will be illustrated, when necessary for clearness, by examples that will bring out essentials and important details of short-span bridge building, giving an intelligent idea of what is available and customary under various conditions likely to prevail, and to be helpful, whether the work is done by force account, special contractors, or under the supervision of engineers accustomed to construction work which does not involve very great difficulties, dangers or expense requiring the services of specialists. There will be descriptions of methods and plants for building piers and abutments, for storing and handling materials, mixing and conveying concrete, for the construction of concrete arch spans, slabs and girders, and for the erection of steel spans, the different articles appearing from time to time in such sequence as may be found convenient.

Traffic Justification for Highway Construction

At a meeting on April 13 of the members of the Asphalt Association, six resolutions were passed, urging the passage by Congress of a second federal aid appropriation, that highway management be divorced from politics, that the United States join the Permanent International Association of Road Congresses, that the Interstate Commerce Commission be urged to authorize reduction in freight rates on road materials, that public officials give employment to the hundreds of thousands of men now out of work by as much road construction as possible, and that "every highway be required to show traffic justification for its construction, thus guarding against extravagance and waste."

That the selection of roads in preparing the road construction program of a given state should be based upon the demands of traffic would seem to be most self-evident, and yet it is only too customary for states to give comparatively little thought to this, but rather to base the apportionment on the political importance of counties, communities or individuals who specially urge certain routes. Some states frankly announce that the counties that pay the heaviest taxes are entitled to the most money for highway improvement, while this general principle is frequently followed still further by permitting the political boss of the county to select the roads to be improved in that county.

While it is true that in a general way the counties paying the most taxes are those providing the most traffic, and the cities occupied by the most voters are those towards which the heaviest traffic is concentrated, this method of selecting routes for improvement too frequently works disastrously and most wastefu'ly, illustrations of which can be found in almost every state.

There can be no question that the only economical and logical method of apportioning improvement funds is to make a study of the traffic requirements of the entire state, regardless of county or other political boundaries, select those routes that are of first importance from a traffic standpoint, those of secondary importance, and others of less relative importance, determining the relative amounts of traffic to be anticipated for each of the routes during the next few years, and then, knowing the funds available and the amount necessary to place each of these routes in a condition capable of carrying the estimated traffic, apportion the available funds to the greatest advantage of all the traffic.

It is not now and never will be practicable to give a high-class roadway surface to every mile of road in the country, nor would such a program be financially defensible.

The solution of the problem along these lines is by no means a simple one, but requires the best judgment of those expert not only in highway construction but also in traffic determination, and must take into consideration the probable development of traffic-providing industries which may be brought about by the improvement of the highways; recognizing that under some conditions and in some localities such improvement may itself so stimulate traffic as to increase it very greatly over that which is now upon the highway in question. In other cases there may be several routes connecting two traffic centers, each about equally favored by present traffic, but the improvement of one of these may result in concentrating upon it practically all of the traffic now using the several routes.

These are only a few suggestions of the intricacy of the problem of determining traffic justification, but the difficulty should not be taken as an excuse for adopting a simpler solution, but rather should lead to the concentration upon this of the best intellects of the country. Where hundreds of millions of dollars are being spent annually on road construction, it is of the highest importance to the country at large, both as users of highways and as taxpayers, that the money so spent be placed where it will be of the greatest advantage.

Why Highway Construction Prices are High

There has been evident recently a disposition among certain officials and publications to regard as profiteering the bids for highway construction submitted by contractors that were larger than the estimates of the officials. The contractors, however, defend these as reasonable and inevitable in that they prefer to bid on facts and to base their prices on actual present costs instead of discounting a possible future fall in prices that does not promise to come rapidly and may even be preceded by a rise in the cost of some items. As one illustration, the governor of Ohio requested the highway commissioners of that state to consider reducing their estimates for all roadway projects by 20 per cent, because of his anticipation of a reduction in the cost of supplies.

An article in the "Bulletin," by Ward Christy, engineer of the Associated General Contractors, shows by figures taken from the reports of the United States Department of Labor at 14 of the largest cities, that the average increase of prices from February, 1920, to February, 1921, amounted to 18 per cent for gravel, 16 per cent for sand, and 19 per cent for cement. He also presented a very illuminating table of freight charges for the 5,166 tons of cement, sand and gravel required for the construction of one mile of standard 18-foot concrete road from 7 to 8 inches thick, made with 1:4:6 mix. Assuming these materials to be hauled by rail from the points from which they are usually shipped to ten important cities located in all parts of the United States, he shows that the present freight charge per mile of road built in different localities varies from $1,310 in Seattle, Wash., where both sand and gravel are produced and cement is only hauled from Bellingham, Wash., a distance of 119 miles, to $11,119 at Denver, Col., where sand and gravel are hauled 119 miles and cement 145 miles. For these two cities the total increases in freight charges since August, 1920, are $291 and $2,967, respectively. In Boston, where the sand is hauled 46 miles,

gravel 24 miles and cement 302 miles, the present freight charges are $7,750, showing an increase of $2,203 since August, 1920, and an increase of $4,065 since January, 1917, before the railroads went under government control.

It is further pointed out that a large road building plant may cost $100,000 and be subject to fixed charges, exclusive of operating expenses, of more than 30 per cent of the initial cost; and it follows that if the other items of fixed charges are in corresponding proportion it would require reduction of cost of variable charges, such as both labor and materials, of 30 per cent to effect a reduction of 20 per cent in the total cost of the work.

Added to this is the certainty that the big boom that is so earnestly desired in general building construction will, if it materializes in the coming season, greatly retard road construction, consequently increasing its cost.

Undesirable Immigration Legislation

The Inter-racial Council has issued a strong appeal to oppose drastic restriction of immigration at the present time. It says, in part:

"The Dillingham Bill, limiting immigration to the United States for 15 months to 3 per cent of the number of each nationality in the United States, has been killed through the exercise of the 'pocket veto' by President Wilson. This bill, which in the closing days of the session was substituted by the Senate Committee on Immigration for the Johnson Bill and was passed by both houses of Congress, was referred to the President on February 28.

"The general effects of this bill will be: To permit a very limited number of new aliens to enter the United States; to create considerable international misunderstandings because of apparent discriminations against certain nationality groups; to arouse opposition and bitterness among races now resident in the United States who have received no official recognition as a 'nationality' and who will have no definite assurance as to the number of their respective races that may enter, and to prevent the re-union of families of our alien residents.

"This bill was passed to meet an alleged emergency which, after three weeks of public hearings, the Senate Committee on Immigration showed did not exist for the following reasons: (1) Foreign nations were enacting regulations to keep their emigrants at home where they are needed, (2) steamship carrying capacity is limited to a total of 800,000 during the year, (3) Quarantine laws are sufficient to prevent the spread of disease which no percentage test can affect, and (4) existing laws are adequate if enforced."

A committee representing the Associated General Contractors has, in conference with the National Federation of Construction Industries Committee and Senator Sterling, author of the Sterling Bill, decided to oppose immigration restriction measures of an emergency nature, and to support a permanent, constructive immigration policy.

Building Construction Outlook

An investigation by the Fidelity & Deposit Company of Maryland, has disclosed that building operations are increasing everywhere in the United States except in New England and in the mountain states of Montana, Idaho, Wyoming, Colorado, New Mexico, Arizona, Utah and Nevada. There has been an increase in productivity of labor per man since September. Building trade wages have fallen appreciably in all states except New Jersey, Illinois and in the New England states.

In general, the cancellation of orders has stopped, there is a marked resumption of industrial activity. Buying by the public is still restricted, retailers have not stocked up in expectation of good spring business nor have their prices dropped, although the cost of living is shown to have fallen appreciably since last September. The questions of taxation, railroads, peace and tariff have the greatest bearing on business prosperity, and the repeal of the excess profits tax and the substitution of a sales tax is universally desired.

Recent Highway Prices

The Wisconsin Highway Commission has recently received bids on several highway contracts, three of which were let in April.

One was for about 13,000 cubic yards of grading, concrete culverts and corrugated metal culverts on Project No. 231. The successful contractor's bid was $.53 for earth excavation, $.53 for borrow, $22 a yard for concrete culverts, $2.75 a lineal foot for corrugated metal culverts and $150 per acre for clearing and grubbing. His total bid was $10,355. Another bid was only $9 higher and there were in all six bids under $13,500 and one bid for $15,070.

On Project No. 257, 14 bids were received, ranging from $48,745 to $69,668, with 8 of the bidders not bidding on the gravel surfacing. The contract had not been awarded at our latest advice, but the itemized bids of the low bidder on the total contract was $.49 for earth excavation, $.49 for borrow, $24 for concrete culverts, $1.99 for gravel surfacing, $.75 for guard rail and $180 for clearing and grubbing.

On Project No. 193, 3 bids were received and the contract awarded to the low bidder. His total bid was $36,789 while the highest bid was $47,657. The low bidder's itemized bids were: Earth excavation $.50, rock excavation $.80, concrete culverts $24, 24-foot feather-edge gravel surfacing $2.20, guard rail $.75 a lineal foot, riprap $5 a cubic yard, borrow $.50, paved ditch $3 a cubic yard, road grader $350.

Federal Aid Project No. 233 was awarded to the lowest of five bids. The total of the lowest was $10,332 and the highest bid was $11,687—a remarkably small difference between maximum and minimum of five bids. The successful bidder's itemized bids were: Earth excavation $.45, borrow $.45, class A concrete $21, gravel surfacing $1.50, shale surfacing $1.15.

WORK DONE DURING 1920 AND CONTEMPLATED DURING 1921 (Continued)

	During 1920			During 1921		
County and State	Money spent for hwy. work	Kind and amount of surface laid	Amt. done by contract & by employees C—contract E—employees	Money available for hwy. wk.	Kind & amt. of surface to be laid	Amount to be done by contract and by employees C—contract; E—employees
Iowa (continued):						
Cedar	$341,617	mac., resurfacing	$7,811 C $120,812.47 C	$244,000	20 grading	all C
Cerro Gordo	7,[illegible]	15 concrete	all C	500,000	13 conc.	all C
Cherokee	220,000	15 grave.	graveling E 14 grading C	250,000	15 grading etc	all C
Clay	74,[illegible]18	32.81 gravel	all C	175,000	$25,000 gravel	...
Crawford	150,000	earth	all C	250,000	$150,000 earth rd	all C
Dallas	255,66[illegible]4	15 — ravel	all C	250,000	60 gravel	all C
Delaware	100,000	24 grading	all C	180,000	70 grading, 31 grav.	11 grading E, rest C
Des Moines	38,606	grading & draining	maint. E	350,000	7.25 conc. pav.	all C
Dickinson	25,000	s gravel	S-C	125,000	5 conc. pav.	all C
Dubuque	200,000	none	50% E 50% C	275,000	.....	25% E, 75% C
Emmet	139,167.87	2 earth, 9 gravel	all C	61,683.33	none	.....
Floyd	586,915.18	581,644.80 pav. or hard surface, 38,231.15 gravel	gravel E rest C	.....	5.56 hard surfacing, 15 graveling	grave. E, rest C
Greene	147,910.18	1 prv., 35,000 yds. grad.	all C	.....	5.4 conc. pav.	all C
Grundy	81,000	77,000 earth grades	all C	157,000	$65,000 earth grades	all C
Guthrie	.....	2.8 earth, 2 gravel	all E	.....	12 earth	all C
Hamilton	325,000	30 gravel	all C	150,000	10 gravel	all C
Harrison	146,000	14 earth	$42,000 C	300,000	20 earth	all C
Iowa	49,643.18	none	$29,682.53 E $19,960.65 C	185,000	183,000 cu. yds. earth	$182,000 C
Johnson	186,800	none	all E	350,000	3½ conc pav., 20 earth	all C
Kossuth	350,000	3 grad., repairs	all C	400,000	100 grad., 40 graving.	all C
Lee	279,451.53	3.6 conc. pav.	$9,450 C 150,004.10 C	300,000	4.3 conc pav.	all C
Lucas	170,000	no surfacing	¼ E ¾	150,000	10 bdg. to perm. grade	all C
Lyon	109,000	$15,000 br & culv., 26,000 gravel, 31,000 earth, 5,000 maint.	maint. E rest C	165,000	$63,000 perm. grade 35,000 br. & culverts, 12,000 maint.	maint. E, rest C
Madison	32,389.87	.....	all E	200,000	11.355 grad. & brdging.	all C
Mahaska	45,000	none	day labor	200,000	$170,000 grad. &drngc.	$20,000 E 150,000 C
Marshall	150,000	13½ earth	$150,000 C	180,000	5.93 conc.	all C
Monona	173,655.[illegible]	none	.....	288,000	32 perm. grading	all C
Monroe	80,000	dirt	all C	100,000	100,000 cu. yds. earth	all C
Montgomery	424,000	none		50,000	none	90% E, 10% C
Muscatine	174,371.94	none		95,000	50½ perm. grading	all C
O'Brien	300,170.71	$48,028 conc., rest earth	all C	1,000,000	22½ conc pav.	all C
Palo Alto	272,000	24 grad., 11 grav., 20 til.	all C	240,000	9.[illegible] 14 gravel, 1 grading	all C
Pocahontas	285,643.78	19 earth, 12½ gravel	all C	350,000	27 gravel, 14 earth, 24 tead tiling	all C
Sac	.....	40 gravel	culver s & bridges & roadwork	2[illegible]0	40 gravel	all C
Scott	658,988.[illegible]	3 mile 2 brick pav., 8 base for brick pav.	all C	1,700,000	25 pav., $100,000 conc bridges, 35 grading	.....
Tama	112,000	none	.....	240,000	30 grading & drngc.	maint. E, rest C
Union	80,000	none	all C	200,000	$160,000	$75,000 E, $5,000 C
Van Buren	120,000	10 prim. & grad.	½ E ½ C	120,000	16 primary & grading	½ bridges E grading C
Wapello	216,675.66	$71,000 grade, $70,000 rd ..., $75,000 bridge	all C	200,000	18 perm. grade	all C
Warren	104,572.[illegible]	none	none	350,000	200,000 cu. yds. grading, 9,700 lin ft tile	all C
Webster	113,[illegible]	[illegible]avel	all C	280,000	21.5 gravel, 9 gravel surfacing	all C
Winnebago	73,[illegible]	none	none	300,000	perm. grade & drngc.	$20,000 E, $280,000 C
Winneshiek	.....	gravel	all E	160,000	8½ gravel	all C
Kansas:						
Allen	285,154.19	92 conc., 3 mac., [illegible]	conc. C rest E	.....	2 conc., completion of mac.	all C
Anderson	295,000	7[illegible]	$60,000 C $175,000 C	190,000	9 gravel, 180 grading	all E
Atchison	200,000	[illegible]	all E	200,000	conc.	all E
Barber	144,000	dirt	$100,000 E 44,000 C	125,000	grading	100,000 E, 30,000 C
Barton	125,572.91	dirt, conc.	all E, exc. 1 proj.	70,000	150 grading	all C
Brown	124,265	[illegible]	$50,000 C 74,265 C	150,000	no hard surfacing	½ E, ½ C
Cherokee	90,575.73	$37,109.67 chat [illegible] earth	all E	500,000	3 conc., 13½ chat, br.	all C
Crawford	169,000	10 chat	all E	155,000	30 grading & bridges 4 conc. 10 brick	all C
Elk	27,000	3 gravel, 2 mac.	all E	27,000	same as 1920	3 gravel, 1 mac. E 1 mac. C
Finney	76,000	1[illegible] earth	63[illegible]	1,350,000	150 grading, 27 conc.	earth E, conc. C
Geary	217,000	[illegible]	all C	219,000	43 conc	all C
Graham	10,000	earth	grad C, rest E	250,000	grading & maint	all E
Greeley	5,000	.....	all E	5,000	earth	all E
Harper	90,000	[illegible]	all E	150,000	.....	all E
Jackson	100,000	[illegible] mac.	2 mac E rest C	144,000	90 dirt, 6 mac	all C
Kingman	178,000	17 dirt, 2½ maint	all E	85,000	gen. repr. & maint.	all E
Labette	275,000	[illegible]	all C	150,000	24 gravel	all C
Lyon	120,000	[illegible] 60,000 gravel	½ E ½ C	120,000	100,000 conc., 130,000 earth	30,000 E, 200,000 C
Marion	70,000	dirt	.....	75,000	grading	all E
McPherson	46,500	.....	.....	45,000	dirt	all E
Meade	60,000	5.[illegible] [illegible] reconstructed	[illegible]	27,000	earth	all E
Montgomery	141,029.13	[illegible]	7.2 C bridges & culv. conc. C	550,000	10 conc., 60 earth	earth E, conc. C
Montgomery	275,000	10 [illegible]	3 E, 7 C	300,000	11 gravel	11 E, 3 C

WORK DONE DURING 1920 AND CONTEMPLATED DURING 1921 (Continued)

	During 1920			During 1921		
County and State	Money spent for hwy. work	Kind and amount of surface laid	Amt. done by contract & by employees C—contract E—employees	Money available for hwy. wk.	Kind & amt. of surface to be laid	Amount to be done by contract and by employees C—contract. E—employees
Kansas (continued):						
Nemaha	$200,000	earth	25,000 E 175,000 C	$120,000	earth	.....
Norton	40,000	none	20,000 E 20,000 C	60,000	maint.	road work E bridge work C
Osage	48,000	perm. grading	all E	57,000	same as 1920	all E
Pawnee	27,000	2 gravel, 80 earth	all E	99,500	5 gravel, 90 earth	all E
Russell	20,000	dirt	8,000 E 12,000 C	15,000	dirt	7,000 E. 8,000 C
Sedgwick	523,125.78	brick, conc. sand clay & earth	354,539.30 C	350,000	3¾ conc., 9½ brick	150,000 E 200,000 C
Shawnee	200,000	10 conc., 5 gravel	gravel E conc. C	300,000	40 grading & culvrts.	all C
Smith	21,656.96	.....	all E	.....	.....	all E
Stafford	20,000	gravel on dirt rds.	all E	.....	gen. upkeep	all E
Wabaunsee	50,000	none	....	50,000	$20,000 dirt	all E
Kentucky:						
Allen	52,500	5 earth, 3 gravel	all E	26,000	earth, gravel	all E
Barren	.....	.....	....	100,000	26 rock asphalt	all C
Bracken	50,000	15 mac.	all C	115,000	17 mac.	all C
Daviess	150,000	river gravel	$115,000 E 35,000 C	150,000	10 river gravel	all C
Fleming	26,000	maintenance	....	16,000	3 resurfacing, 1 mac.	all C
Graham	10,000	limestone 6 E		Indef.	8 limestone & gravel	all C
Hopkins	60,000	23 grading & draining	all C	500,000	17 gravel, 12 fed. wk.	all C
Marion	50,000	none	....	.....	repair & maint.	all E
Montgomery	45,000	10,000 mac.	all E	25,000	.....	co. money E. Fed. C
Morgan	35,000	earth grade	all E	150,000	grading	all C
Oldham	30,000	mac., gravel	16,000 E 14,000 C	....	.....	.....
Owen	52,000	12 mac.	all E	35,000	5 mac.	.....
Pike	30,000	.....	.....	.....	25 mi., 26 in. bit. mac.	all C
Rockcastle	92,000	3 grad. & mac., 3 grading	3 grad. & mac. E 3 grad. C	200,000	5 grading & mac., 2 grading, bridge	5 grading & mac., 1 grading E. 1 grading bridge C
Shelby	104,000	maintenance	all E	100,000	23 bit., 300 mac. mnt.	maint. E, 23 C
Whitley	244,800	23 graded road	52,800 E 192,000 C	.....	10 Ky. asphalt	all C
Louisiana:						
Avoyelles	300,000	60 graded, conc. drainage structures	all C	1,500,000	75-100 graded conc., drainage structure	all C
Caldwell	200,000	13.7 fed. aid, 70 Parish rds.	all C	200,000	16.6 fed. aid, 13.7grav.	all C
Maine:						
Knox	50,000	gravel	all C	.....	gravel & dirt	all C
Maryland:						
Kent	134,000	2 conc. 15 mac.	all C	78,000	5 conc.	all C
Massachusetts:						
Athol	42,000	1½ gravel	....	50,000	2,300 sq. yd. conc. gravel	.....
Essex	507,943.88	2 bit. mac., cem., conc.	all C	181,700	bit. mac. gravel	all C
Milton	.....	2,503 war.-bit.	....	.....	.....	.....
Michigan:						
Alger	127,000	4 mac.	all E	125,000	5 mac., 4 earth, 3 asp. pen.	5 mac. E, rest C
Cass	250,000	gravel & conc.	1 mi. C rest E	200,000	2 conc., 50 gravel, 2 bit. mac.	90% E, 10% C
Dickinson	117,035.76	3 grav., 2 bit. mac.	1.02 bit. mac. E 4 C	290,000	6.5 gravel, ½ bit. mac., 4.8 grading	bit. mac. & grad. E, gravel C
Eaton	204,000	28 gravel	5 E, 23 C	250,000	60 gravel	5 E, 55 C
Emmet	90,000	21 bit. mac., 5 gravel	all E	100,000	20 gravel	30% E, 70% C
Grand Traverse	54,398.15	gravel	2-3 E, 1-3 C	60,000	gravel, stone, conc	⅓ E, ⅔ C
Kalkaska	27,564.23	none	all E	60,000	gravel	all C
Lapeer	150,000	gravel	all C	Indef.	25 gravel	all C
Luce	66,000	3¾ gravel	all E	75,000	4 mac.	all E
Macomb	1,000,000	3 conc., 12½ gravel	all C	500,000	10 conc., 14 gravel	all C
Mason	85,985.84	6 gravel	all E	125,000	11 gravel	6 E, rest C
Missaukee	40,500	5 gravel	2 E, 3 C	135,000	14 gravel	3 E, 11 C
St. Joseph	15,000	110,000 gravel 40,000 conc.	gravel E conc. C	400,000	.....	50,000 E, 350,000 C
Minnesota:						
Aitkin	58,400	gravel	14 E, 16 C	175,000	20 gravel	10 E, 10 C
Big Stone	207,500	21 gravel, 27 top soil	all C	192,000	27 gravel, 15 topsoil	all C
Blue Earth	217,147.76	gravel maint.	all C	250,000	20 grading, 25 gravel	gravel E, grad., C
Brown	160,000	grading, graveling & bridges	100,000 E 60,000 C	140,000	graveling, bridge	graveling E, br. C
Carlton	159,979.87	19 gravel, 14½ earth	12 gravel, 4½ earth, E, 7 gravel, 4½ earth C	99,000	10 gravel, 10 earth	10 gravel, 5 earth E, 5 earth C
Carver	95,000	12 gravel	all C	40,000	3	all C
Chippewa	350,000	gravel	10% E 90% C	100,000	.....	50% E, 50% C
Chisago	600,000	27 gravel, 23 gravel with rock top	all C	250,000	5½ conc., 10 gravel	all C
Cottonwood	240,000	30 gravel	all C	120,000	14 grade, 10 gravel	all E
Dakota	.....	43,594 war.-bit.	....	.....	.....	.....
Dodge	234,362.06	10 grading, 8½ grav.	all C	409,521.57	18½ grad., 17 grav.	all C
Faribault	196,351.35	21 gravel	6.5 E, 14.5 C	308,855	27.3 perm. grade, 21 gravel	10 grav. E. rest C
Goodhue	393,662.93	3.5 conc., 40 gravel	37 gravel E rest C	170,000	7 grading, 25 gravel	gravel E, grad. C
Grant	100,000	10 earth, 12 gravel	9 gravel E rest C	60,000	5 earth, 10 gravel	gravel E, earth C
Hennepin	.....	94,583 war.-bit.	....	.....	.....	.....
Hubbard	30,000	1.5 gravel	all C	280,000	48.42 gravel	all C
Isanti	129,463.28	9½ grading, 13.75 gravel	5½ gravel C rest E	Indef.	.....	all E

(To Be Continued)

NEWS OF THE SOCIETIES

May 2—MILWAUKEE CHAPTER, AMERICAN ASSOCIATION OF ENGINEERS. Milwaukee, Wis.

May 3 — CLEVELAND SECTION, AMERICAN SOCIETY OF MECHANICAL ENIGNEERS. Engineering Societies Rooms.

May 9 — HARTFORD BRANCH, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Get-together dinner at City Club.

May 9-11 — AMERICAN ASSOCIATION OF ENGINEERS. 7th annual convention. Buffalo.

May 9-11 — NATIONAL CONFERENCE ON CITY PLANNING. Pittsburgh, Pa.

May 9-12 — SOUTHWEST WATER WORK ASSOCIATION, Shirwin Hotel Headquarters, Oklahoma City, Okla.

May 10-12 — CANADIAN GOOD ROADS ASSOCIATION. 8th annual convention. Halifax, Can. Secretary George A. McNamee, Montreal.

May 16-18—AMBASSADORS & MINISTERS OF WORLD TRADE. Conference under auspices of NATIONAL ASSOCIATION OF MANUFACTURERS. New York City.

May 17 — CLEVELAND SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual dinner.

May 17-19—NATIONAL FIREMEN'S ASSOCIATION. Twenty-third annual convention. Fort Wayne, Ind.

May 18—BIRMINGHAM SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Annual business meeting. Southern Club.

May 19—EASTERN NEW YORK SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Edison Club Hall, Schenectady.

May 19 — SAN FRANCISCO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

May 20 — AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, 370th meeting. Engineering Societies Building, New York City.

May 20 — PHILADELPHIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Annual dinner, Hotel Adelphia Roof.

May 21 — ATLANTA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with ATLANTA SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

May 21 — CENTRAL PENNSYLVANIA SECTION. Spring meeting. State College with headquarters at University Club.

May 25-6: NATIONAL INDUSTRIAL TRAFFIC LEAGUE. Cleveland, O

May 23-26 — AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Spring meeting. Congress Hotel, Chicago.

May 31-June 3—NATIONAL ELECTRIC LIGHT ASSOCIATION. Pasadena, Cal.

June 15-17—LEAGUE OF MICHIGAN MUNICIPALITIES. Annual Convention. Kalamazoo, Mich.

Sept. 28 (10 days)—NEW YORK ELECTRICAL EXPOSITION. Seventy-first Regiment Armory, New York City.

Oct. 11-14—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual Convention, Atlanta, Ga. Hotel Ansley. Secretary, James J. Mulcahey, Municipal Building, Denver, Colo.

Oct. 24-8: AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Southern Hotel, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Nov. 14-18 AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

BROOKLYN ENGINEERS' CLUB

At the meeting of April 21, "Government Control of Professions with Particular Reference to Proposed Legislation for Regulating the Practice of the Engineering Profession" was discussed by William P. Bannister, secretary of the State Board of Examination and Registration of Architects, a member of the Joint Committee of the National Council of Engineers and Architects, and a member of the Constitutional Convention of 1915.

April 28, "Handling Bulk Material in Large Quantities" was described by A. B. Proal, Jr., engineer with Robins Conveying Belt Company, and illustrated by moving pictures of the world's largest lime stone plant, the operation of a self-unloading boat and automatic coal handling machinery at B. & O. station.

AMERICAN SOCIETY OF CIVIL ENGINEERS

May 4 Ernest E. Howard presented a paper on "Vertical Lift Bridges," discussing the historical development of the lift bridge, the general elements of design, and a detailed description of three types—the lifting span, the lifting deck and the combination lifting span and lifting deck.

A complete series of lantern slides illustrating various types and details was shown, including views of the Columbia River Interstate bridge, the North Kansas City bridge and the Harriman bridge at Portland, Ore.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The 1921 spring meeting of the American Society of Mechanical Engineers is to be held in Chicago May 23-26, at the Congress Hotel.

Well developed programs will be presented by the professional divisions of the society devoted to Forest Products, Fuels, Machine Shop Management, Material Handling, Power, Railroad, and a specially important session will be devoted to Training for Industries. The Chicago committee, jointly with the Western Society of Engineers, is preparing a session on "Chicago as the Rail-Water Gateway."

The application of material handling machinery to road building has been adopted by the materials handling division for its spring meeting program. The highway needs of the country are great and the province of the mechanical engineer in satisfying these needs is well defined. Instead of excursions, a number of moving pictures will be shown in which the uses of road building machinery will be displayed to those attending the meeting.

The program of papers includes: "Planning and Organization of a Road Job for the Mechanical Handling of Material," C. D. Curtis; "Road Plant Operations, with Practical Analysis of Operating Road Plants," B. H. Piepmeier; "What the Contractor Needs," Gen. R. C. Marshall, Jr.

Visits to a great number of points of engineering interest in Chicago will be arranged. Special attention is being given to the corelation of plant visits with the technical sessions.

En route to the meeting, the society, jointly with the Society of Automotive Engineers, will stop at McCook Field on Saturday, May 21, for an inspection of the facilities of the field.

On May 27-28, the Friday and Saturday following the meeting, a joint excursion with the Army Ordnance Association will proceed to Rock Island Arsenal, where the Ordnance Division will present papers and enjoy an inspection of the plant. Saturday will be devoted to a handicap golf tournament on the Rock Island links.

THE ASPHALT ASSOCIATION

The second annual convention of the Asphalt Association, held at the association headquarters in New York, April 13, marked important general advances in the road building and street paving field. President Draney predicted that, unless reactionary pessimism grips the nation, 700,000 men will be needed in the building of the 35,000 miles of new highways contemplated this year under the billion dollar road program outlined by the Federal government and the states and counties. Three hundred thousand more men, he said, will be needed in the quarries, gravel pits, cement, brick and asphalt plants and factories devoted to the manufacture of road machinery. The road building boom, he thought, will work great benefit to the railroads by bringing into service one hundred thousand idle freight cars to transport one hundred million tons of road materials.

The association adopted resolutions as follows:

1. Urging Congress to pass the Federal aid appropriation of $100.000.000, thus assuring a continuance of road building under the supervision of skilled state and Federal engineers.

2. Urging that highway management be divorced from politics and all materials and methods entering into highway construction be placed in open competition.

3. Declaring that every highway be required to show traffic justification for its construction, thus guarding against waste and extravagance.

4. Memorializing Congress to authorize the United States to join the Permanent International Association of Road Congresses made up the highway departments of all nations.

5. Urging the Interstate Commerce Commission to authorize a reduction in freight rates for road materials, thus stimulating the road building program.

6. Recommending that public officials carry forward road building programs to the extent permitted by appropriations available, thus giving employment to many hundred thousand men now out of work and utilizing tens of thousands of idle open top freight cars.

The new directors elected were: Henry Fisher, Herbert Spencer, J. R. Draney, F. A. Hogan, J. S. Helm, E. J. Morrison, F. P. Allen, L. M. Law, H. B. Pullar, G. H. Perkins, W. T. Headley, J. E. Clark, Richard Pebworth, B. F. Richardson and Michael White.

The directors elected F. P. Allen as vice-president and re-elected J. E. Pennybacker secretary.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

HIGHWAY CONSTRUCTION EQUIPMENT

A circular issued by the Conant Machine Co. illustrates and describes 7½ h. p. collapsible loading machine and 5 h. p. loading machine, both mounted on trucks and useful for handling coal, sand, crushed stone and other loose and heavy materials, especially for road building purposes. They may be fitted with gravel screening apparatus and used with or without connections to the elevating and screening plant and storage bins made by the same company that also supplies the electric motors, gasoline engines, wheels, elevator buckets and chains and are manufactors of tractors, trailers, steam rollers, stone crushers and dump wagons.

SWIVELING LOADER TRAVERSED BY HAND WINDLASS

They especially recommend a swiveling loader of the same dimensions as the collapsible machine, with the lower end of the bucket elevator traversed 6 feet laterally, by a hand windlass, enabling the elevator to clear its own path with little shoveling.

STROUD ROAD MAKING MACHINERY

Catalog No. 21 of Stroud & Co., illustrates elevated graders, wheel scrapers, drag scrapers, little red wagons, blade scrapers, dump carts, highway maintainers, Fresno scrapers, truck bodies, road plows, drags for scrapers and bulldozers.

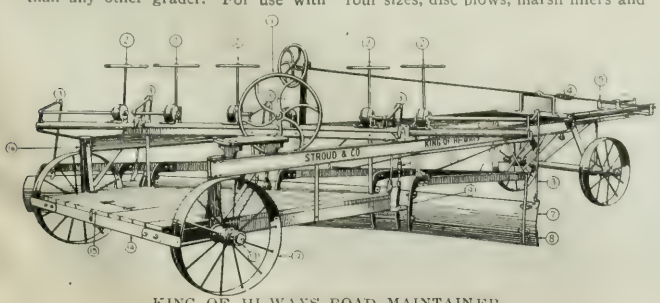
The elevator graders, made in two sizes to be hauled by teams or tractors, are designed to move more dirt per horsepower and at less expense than any other grader. For use with the graders there are offered little red dump wagons of 1½-yard capacity and big red dump wagons of 3 to 5 yards capacity, adapted for large loads on long hauls. These wagons are provided with a ratchet dump, a trailing guide and are constructed so as to be turned around within their own length.

The "King of Highways" road maintainer has four blades held firmly to the ground by eight pushrods giving them positive action and they are all lifted by a master worm gear that enables them to be rapidly elevated 40 inches or quickly lowered to working position. Each blade is controlled by a smaller worm gear enabling it to be set as desired, thus conforming to a horizontal or curved cross section and assuring accurate crowning.

The reversible road machines are made with blades up to 12 feet long that are firmly held in position by screws. The pull on the blade is direct to the tongue, putting no strain on the frame, while the rear axles take care of the side draft so that the machine is always in line with the work.

The adjustable road drag has two 7 or 8-foot blades for use in spring in maintaining good roads while the earth is soft.

There is a large line of bowl drag scrapers, butt scrapers, tongue scrapers and wheel scrapers, grading plows of four sizes, disc plows, marsh fillers and other road building and maintaining equipment.



KING OF HI-WAYS ROAD MAINTAINER

18000-POUND LITTLE RED DUMP WAGON SERVING ELEVATING GRADER MACHINE

AUSTIN MOTOR SWEEPER

This is claimed to be the latest and most sanitary street cleaning machine on the market. It sprinkles, sweeps, collects and transports to the dump quickly, silently and economically.

The specially designed chassis conforms to model A of the United States Government truck specifications and the engine develops 41 h. p. It is specially constructed to endure severe conditions and hard service.

The large water tank and spraying equipment in the front of the machine wets the dirt before sweeping and eliminates dust.

The rear or pick-up broom, 36 inches in diameter and 7 feet long, has low and high speeds for regular service and for especially dirty streets, respectively. The conveyor, water spray, pump and gutter broom are operated at the same speed simultaneously. The rear broom contains 175 pounds of bamboo fiber 12 inches long, retained in alignment by automatically adjustible end disks, with spindles running in oil-tight boxes. The broom is enclosed in a steel housing and is suspended from springs regulating the pressure on the pavement.

The gutter cleaning broom, 42 inches in diameter, projects 5 inches outside the rear wheels and is inclined so as to enable the gutter dirt to be thrown in the path of the pick-up broom. It has steel fibers 12 inches long held in position by aluminum castings. It is chain driven with self-aligning ball bearings and is operated by a special clutch.

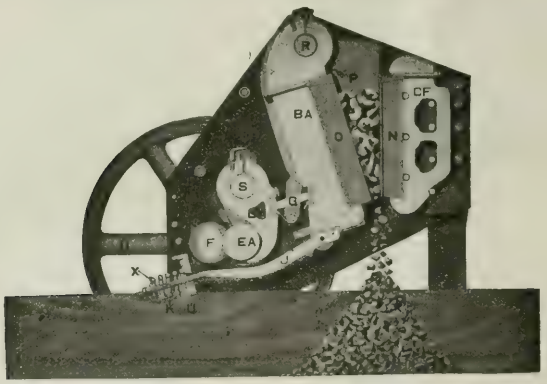
The elevator is of unique design especially intended to eliminate difficulties usual with elevating graders. It has a series of heavy steel and rubber squegees continuously moving upward on a steel plane that pick up the dirt that is continuously delivered to the elevator and carries it into the hopper, handling earth, stone, slush, broken bottles and the like without difficulty. The elevator hangs higher than other types, giving an increased clearance, and is absolutely dependable.

The steel hopper of more than 2 yards capacity is dumped through bottom doors operated from the driver's seat. The hopper is designed to be filled at about the same time that the water tank is emptied, so that both can be emptied and filled simultaneously. All shafts have self-aligning bearings and automatic lubrication. Machines have already been installed in Chicago, in Akron, Ohio, in Rochester and other cities.

CHAMPION MACHINERY

Champion crushing, elevating, screening and conveying machinery, catalog published by the Good Roads Machinery Company, illustrates and describes the principal details and general features of the steel rock crusher mounted on a steel frame truck with folding type of wood frame elevator. The No. 4½ machine has a 10 x 20-inch opening and a large capacity and is built for heavy usage.

Telescopic storage bins of 15, 20, 30 and 40-ton capacities are fitted with revolving cylinder screens and loading gates, and are mounted on wheels for easy transportation.



SECTIONAL VIEW OF ROCK CRUSHER

Both buckets and belt conveyors are listed, as are portable engines and boilers of 4 to 50 h. p. The belt conveyor can be equipped with a discharge carrier that will work automatically back and forth to discharge material evenly along a given space, or set to discharge material at any given point on the line of the conveyor.

The Good Roads catalog describes six sizes of Winner graders, the smallest for use with two horses, and the largest, with a 12-foot blade to be hauled by a tractor. The Killifer scarifier has five massive adjustable teeth and can be drawn by a tractor or steam roller. There are two and three-blade road drags, and there is a road hone mounted on wheels for smoothing, leveling and surfacing dirt roads. There are Monarch road rollers, oiling and heating machinery, street sweepers and sprinklers, steer sweepers and portable engines and boilrs. There are also corrugated metal and interlocking cast iron culvert pipes.

HERCULES AJAX—ON HIGHWAY CONSTRUCTION

Building highways with pre-cast concrete blocks by the Hercules Ajax-On road building method is claimed to secure an indestructible highway of great strength at one-third less than the usual cost and at a minimum maintenance charge.

The pre-cast concrete blocks 6 inches thick are claimed to have a compressive strength three times as great as ordinary concrete and to weigh 160 pounds per cubic foot against 110 pounds for average concrete. They may be continuously manufactured by a small force operating a plant that will provide 100 miles of road surface and that costs no more than the plant required for building 5 miles of ordinary highway.

The blocks are made of cheap local materials shipped to the site by truck or trailer and put in position by the Ajax-On road paving appliance that is provided with a grading plow in front, with block handling apparatus and with horizontal jacks pushing the apapratus forward.

With advantageous weather conditions the units can lay 700 linear feet of finished roadway in one 8-hour shift daily from April 1 to December 1, thus producing 20 miles of 18-foot roadway in one season.

THE AMERICAN GASOLINE LOCOMOTIVE

The American gasoline locomotive, built by the Hadfield-Penfield Steel Company, is designed for industrial activities where a gasoline locomotive is adaptable and is simple, reliable, efficient, easily operated and as nearly fool-proof as possible. It has a friction drive, a Hercules motor, efficient cooling cistern, telescopic couplings, with self-aligning axle and drive chain operation.

It has a very strong, rigid, cast-iron frame, a 4-cylinder, 4-cycle Hercules motor developing 23 h. p. at 1,000 r. p. m., and is built in standard sizes of 4 to 7 tons, and larger sizes to special specifications. The low sizes are especially fitted for tunnel service. The 4-ton machine has a length of 122 inches, height of 72 inches and a width varying from 24 inches to 56 inches, according to gauge. Its speed is up to 12 miles per hour with a draw-bar pull at normal engine speed of 1,600 pounds.

INDUSTRIAL NOTES

The building construction and industrial portions of the Lakewood Engineering Company's line will henceforth be handled by William H. Hale, of William H. Hale & Co., well known equipment dealers of Minneapolis. At the same time the sale of Lakewood paving equipment will be conducted by C. D. Smith, formerly associated with Mr. Hale, at the Lakewood Engineering Company office in Minneapolis.

Vickers-Petters, Ltd., has opened new offices and show rooms at 75B, Queen Victoria street, London, E. C. 4, England, for the exhibition of various types of Petter oil engines and Vickers Petter semi-deisel crude oil engines. Branch offices have also been opened in Glasgow, Bristol and Dublin.

The Brier Hill Steel Co., Youngstown, Ohio, has opened its Pittsburgh district sales offices, with Robert C. Barton, district manager of sales, in charge.

The Carmean Electric Company has been incorporated with headquarters at Kansas City, Mo.

The Gardner Machine Co., of Beloit, Wis., has put H. J. Gaumond, formerly with the Federal Machinery Sales Co., in charge of the Chicago district.

GEORGE A. JOHNSON COMPANY

Announcement is made of the reorganization of Johnson & Benham, Inc., under the new name of George A. Johnson Company, the members of which are George A. Johnson, Nelson B. Wolfe, Harold C. Stevens and Charles R. Wychoff.

The George A. Johnson Company engages in the professional practice of civil, electrical and mechanical engineering.

PRICE REDUCTION

In keeping with the general trend of prices, Yoemans Brothers Company, of Chicago, pioneer manufacturers of sewage ejectors and pumping machinery, have made a decided reduction in the prices of their products, which include the Shone pneumatic sewage ejector, electrically operated centrifugal sewage ejectors, automatic electric bilge pumps, condensation return pumps and horizontal centrifugal pumps for all purposes.

WATERPROOFING CONCRETE

The Truscon Laboratories, Detroit, will send free on application a copy of the new technical pamphlet No. 8, containing: A discussion of why concrete requires waterproofing and the properties an integral waterproofing must possess to operate effectively with the natural properties of concrete. Specifications for waterproofing mass concrete by integral method. Specifications for waterproofing concrete and general masonry structures by means of waterproofed plaster coat. Proportions and quantities of waterproofing required.

DEARBORN TRUCKS

Worm drive, 1½ and 2-ton trucks, are illustrated in catalog of the Dearborn Truck Co., who produce 1½ and 2-ton complete trucks, and the best form truck with which any automobile car can be converted into an economical 2-ton truck.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Municipal Journal and Engineer, Inc.
Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879

Vol. 50 MAY 14, 1921 No. 20

Laying Reinforced Concrete Sewers in Bronx Borough, New York

More than three miles of reinforced concrete sewer pipe up to 66 inches inside diameter cast in yards and laid in trenches in the Borough of Bronx, New York City. Four-foot sections assembled in trench and joints completed at the rate of five minutes each.

The Holland avenue contract for more than one mile of sewer is now being executed by Charles W. McDonald; and the contract for more than a mile of Eden Terrace sewer, and for similar length for the 233d Street sewer, is being executed by the Fenlack Construction Co. The inside diameter of the Holland Avenue sewer varies from 51 inches to 66 inches, while that of the Eden Terrace and 233d Street sewers varies from 24 to 57 inches inside. These contracts are under the supervision of the Department of Sewers, Borough of Bronx, New York City, Col. Austin, engineer in charge. Work is being executed in accordance with the standard specifications of the department for reinforced pipe, the pipe used being manufactured according to their regular standards by the Core Joint Pipe Co., Inc., at two yards established by the company in the vicinity of these respective jobs.

TRENCH EXCAVATION

The trench for the Holland Street sewer is almost wholly in rock excavation, much of it from 20 to 30 feet deep through irregular miscellaneous strata of limestone, shale, micaceous schist and decomposed hard and soft rock, with the strata inclined in every direction, making it difficult to drill and blast. The trench has an average width of about 6 or 7 feet, with very jagged sides because there are no definite planes of cleavage in the rock.

For the Holland Avenue sewer the excavation is made in two lifts or benches, in each of which there are drilled three one-inch vertical holes 1¼ inches diameter at the bottom, that are made with jack hammer machines at the rate of about 22 feet per hour and are charged with 5 or 6 pounds of 60 per cent dynamite cartridges. The holes are placed about 3½ feet back from the front of the bench and the rock is shattered so that little sledging or block drilling is necessary for handling and removing it. An average of two 3-hole shots are fired daily by each of the four 6-men gangs, thus extending the trench about 3½ feet per day, an amount that governs the completion of finished sewer.

The spoil is loaded by hand into one-yard steel tilting buckets, hoisted by a stiff-leg derrick, and dumped alongside, where it remains only a short time, being used in a few days for backfill as fast as the pipe is laid in five or six-section lengths, thus permitting the trench to be backfilled within 40 to 60 feet of the blasting face, according to depth.

PLANT AT HOLLAND AVENUE, BOROUGH OF THE BRONX, NEW YORK, FOR MANUFACTURING, SEASONING AND STORING REINFORCED CONCRETE SEWER PIPE.

PROTECTING BLASTS

The end of the finished sewer is protected by a bulkhead of timber, and the blasts are covered by wire rope mattresses and logs which effectually prevent any damage by flying rocks. The mattresses are made by the contractor at the site at a cost very much less than it would require to purchase them in the market. To make them, short iron stakes are driven about 6 inches apart into the hard, level surface of the ground on the four sides of an 8 x 10-foot rectangle. Around them are wound and tightly stretched ¾-inch wire rope, forming the warp, while a more flexible ⅝-inch rope is wound back and forth transversely, forming the woof of the fabric. The ropes are wound around the stakes by hand, weaving a very close basketwork pattern and making a satisfactory and economical mattress, which will last from two to six months when in constant use. Worn out guy and hoist ropes of no commercial value are used for the mattress, which weighs about two tons and can be made in four days by a single workman.

The drills are operated by compressed air from an Ingersoll-Rand compressor having a capacity of 500 cubic feet of free air per minute, which is installed at the contractor's power plant. The air is maintained at a pressure of about 100 pounds in a receiver of about 200 cubic feet capacity that supplies a Leyner tool dressing machine and four Ingersoll-Rand drills.

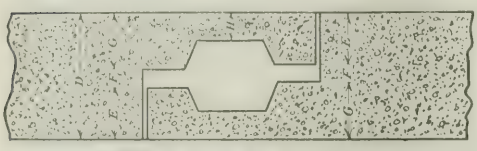
The sections are excavated upgrade and therefore require little pumping except in one or two cases where pulsometers are installed. They require little or no sheeting and bracing except at the crossing under the elevated railroad and adjacent to buried conduits and mains.

MAKING THE PIPES

The pipe used in this work is that known as the "Core Joint" concrete pipe, and is manufactured in yards obtained for the purpose near where they are being laid.

The pipes are cast vertically in sections 4 feet long, made with 1:2:4 concrete with aggregate not exceeding 1 inch in diameter. The thickness varies from 3 to 6½ inches, and the weight from about 600 to 7,000 pounds per section of the sizes used on these jobs. Each section is reinforced by a 4-inch full length cylindrical web of American Steel & Wire Co.'s triangular mesh, concentric with the axis of the pipe and at a minimum distance of 1¼ inches from the inner surface of the pipe. Pipes with a diameter of 48 inches or more have a second similar reinforcement at a minimum distance of 1⅜ inches from the outer surface of the pipe.

The joints are made in the thickness of the regular pipe walls, being flush inside and outside, the exterior of the spigot and the interior of the hub being recessed so as to form, when adjacent sections are assembled together, six-sided annular spaces, which, together with narrow cylindrical spaces separating the ends of the sections, are filled with grout after the pipes have been assembled and aligned. The density of the concrete in the pipes is so great that they have endured a hydrostatic test of 40 pounds per square inch without any sign of percolation or sweating.



CROSS-SECTION OF JOINT OF "CORE JOINT" PIPE SHOWS ANNULAR SPACE TO BE FILLED WITH CEMENT GROUT AFTER PIPES HAVE BEEN LAID

PIPE MANUFACTURE

The pipes for the Eden Terrace and the 233d Street sewers are made in the Boston Road yard conveniently located near the line of the 233d Street sewer. Two-inch planks are laid on the surface of the ground and on them are placed the bottom rings required for the female ends of the pipes, which are cast down. The inside forms are assembled on the rings, after which the reinforcement fabric, cut to required length, is assembled by hand around the inner form, being easily sprung to the required curve and the ends wired together at the overlap, thus forming a cylinder of the exact size of the pipe sections and accurately gauged by the bottom ring which the pipe encloses. When a double reinforcement is required, a second cylinder of triangular mesh fabric is assembled in the same manner, after which the outer form is put in position. As the reinforcing fabric is received in rolls having a width slightly greater than the length of the pipe sections, the reinforcement cylinder is conveniently shortened to the exact length required by making two sharp bends ¾ inch apart, in each of the diagonal wires connecting the upper two circumferential rods of the cylindrical reinforcement, which is thus quickly reduced in length by any required amount less than one inch. This adjustment is very easily effected by a crank handle with slotted bit that engages the light wire and twists it 90 degrees or more with a single motion.

The forms are then filled with concrete, which is thoroughly tamped and rodded with narrow bars inserted adjacent to both outer and inner form shells and between the reinforcement sheets, thus automatically maintaining the latter in accurate concentric positions. Cement mortar is then placed in the top of the form and the top joint rings are pressed down in it and compact it until it overflows and insures that the space is thoroughly filled with mortar enclosing the reinforcement that strengthens the outer edge of the joint.

CONCRETING

The concreting is done by a force of about 6 men and a foreman, who cast 7 pieces of 60-inch pipe in one 8-hour day, or with a force of 10 men and a foreman who can make 13 pieces in one 8-hour day. As the pipe for all these contracts is manufactured for the contractors by the pipe company, the latter has found it convenient to establish a yard at Holland avenue, similar to the one described, and to cast pipes for both jobs by the same force operating at one yard one day and the other yard the next day. This leaves

48 hours for a batch of pipes to set before the men return and strip them, setting up the forms on an extra set of bottom rings and allowing the new pipes to harden for six days more before they are lifted from their bases and moved to position on the storage skids, where they are allowed to harden at least 6 days longer before being laid in the trench. The work is so well planned and carefully executed that practically 100 per cent of the pipes cast have been acceptable to the inspector.

Concrete is mixed in a ½-yard Ransome machine mounted on an elevated platform at one end of the yard that is served by a derrick handling the aggregate and cement, the former being stored on the ground nearby where it is delivered by automobile trucks. The mixer discharges into wheelbarrows which deliver the concrete over a gangway supported by trestles set up as required in the aisle between two rows of forms.

PIPE FORMS

Each yard is equipped with about 25 complete forms and twice as many bottom rings for each size of pipe manufactured there. The inner and outer forms are made of No. 16 gauge sheet steel, each cylinder being made, according to size, in 2 to 4 segments, secured together by joints made with flanges that are almost instantly engaged, tightened, locked and released by a single movement of the knuckle handle. The cast iron joint rings are each made in two or more segments according to diameter and are connected with pins at the ends. They are machine finished to very accurate dimensions and the cylinder forms are thoroughly cleaned by scraping and brushed with oil each time they are used.

PIPE LAYING

From the storage skids in the yards where they are manufactured the pipes are rolled by hand up inclined skids to trucks, on which they are transported alongside the trench as required and delivered to derricks, which lower them to position in the bottom of the trench. If they are too large to be rolled up the inclined skids by hand, they are loaded by the aid of a rolling hitch on the end of a rope operated by a team or an automobile.

In lowering the pipe sections of maximum weights up to 7,000 pounds, they are easily handled by means of special hooks made of forged bars up to 2½ inches square. The hook has two parallel legs far enough apart to clear the walls of the pipe. The long leg, going inside the pipe, is nearly as long as the pipe section, and the short leg is only one half as long, or about 2 feet long, provided with a clevis at the end that is attached to hoisting tackle and automatically spots the latter at the center of gravity of the pipe when the hook is slipped as far as it will go over the end of the pipe.

The pipe can thus be safely handled in a horizontal position without danger of slipping. It is lowered to the bed leveled for it on the bottom of the trench and the spigot end is guided into the bell end of the preceding pipe, and the pipe is carefully aligned. The next section is then laid, and so on, as many as seven sections having been assembled and aligned in 30 minutes. After the pipe has been aligned, a man enters it with a little cement mortar and "muds" the interior joints, about ¼ inch wide, while a similar operation is performed on the exterior of the joints. Holes about 6 inches square are then chiseled in each joint from the exterior at any convenient point, usually at the crown of the pipe, and through the holes is poured 1:1 Portland cement grout of a consistency of cream, that fills the joints completely, after which the pouring hole is plastered up and the joint is finished.

The McDonald contract is being executed with an average force of about 60 men, who under favorable circumstances lay about 50 feet of 66-inch sewer per month. The work on the Fenlack contract is carried on in a similar manner at about the same speed, and by about the same number of men.

PIPE MANUFACTURING PLANT AND YARD, BOSTON ROAD, BOROUGH OF THE BRONX, NEW YORK

Court Powerless to Compel Sewerage

The Supreme Court of Michigan has ruled that no state court can compel a municipality to lay sewers in any particular street or dictate the manner of making any other public improvements. This decision was rendered in connection with an appeal from a mandamus issued by the State Circuit Court last year, on the request of the owner of 322 lots in that district, ordering the city to proceed with the construction of sewers in a certain section of North Detroit. The Supreme Court held that in carrying out public works, municipal authorities are vested with a quasi-judicial discretion and courts have no power to order them to make all alike or to keep all in the same state of repair.

Grading Road With Tractors and Wheel Scrapers

By W. B. Hill, Jr.

Contractor used two outfits of a tractor and two trailers each for hauls exceeding 150 feet. Figures of force employed, dirt moved, etc., and dynamometer test of draw-bar pull.

The Dixon-Henderson road in Webster county, Kentucky, is a Federal Aid project, forming part of the Dixie Bee line running from Chicago to Florida. The section under consideration (Project 39, Sec. C) is about five miles long and winds around the Kentucky hills with few level stretches, and with grades of from 2 to 6 per cent.

The contract calls for moving about 35,000 yards of dirt, putting in some 20 concrete culverts and clearing and grubbing about 2½ acres of ground. Free haul is 500 feet with an overhaul of about 13,000 feet on 5,000 yards. Character of soil is limestone clay, free from rock. The work is being done by Townsend, Mitchell & Carter as contractors.

Work was started in September, 1920, with teams alone. Operations were stopped for the year on December 17. During the last month and a half "caterpillar" tractors and scrapers were used, replacing all except 4 teams. In 1921 work was begun on April 4 with the same equipment—two trains, each consisting of a 5-ton Holt "caterpillar" tractor and two Maney four-wheel scrapers.

The method of operation is to use the tractors on hauls of 150 feet and up, and teams and slip scrapers on all of the shorter hauls. This gives the contractor an equipment so flexible and efficient that he can handle any given condition with maximum economy.

The efficiency of teams is well known on hauls of around 100 feet, on hauls across the road, knocking down short steep banks, filling up deep holes and washouts, etc. But where teams begin to cost real money is on the longer hauls. It is this condition that the tractor-drawn wheel scrapers handle best.

The following are typical examples of the amount of dirt these outfits have moved: Working up and down a 6 per cent grade that was to be cut to 5 per cent, on an overhaul of about 1,300 feet, Mr. Mitchell found that one tractor outfit averaged him about 120 yards a day and the two outfits about 240 yards. On another hill, of 5 per cent grade, he found he was averaging around 200 yards with each outfit on a 600-foot haul per 10-hour day.

Six men are employed as operators; 2 on the tractors and 1 on each of the 4 scrapers. On hauls of around 200 yards, one power outfit loads 180 yards from the fill; second outfit 220 yards from fill. This prevents delays. On longer hauls this is unnecessary. One scraper man is generally used to handle a train of 2 or 3 Maneys, but Mr. Mitchell has found it better economy to use one man on each scraper for the following reasons:

1st—They take better care of scrapers and keep them in better running order.

2d—They take a great interest in their particular scraper.

3d—They like the job because seat is very comfortable and work is not hard.

4th—They can get a bigger load per trip.

5th—They can make a smoother, evener cut.

6th—They are a great help in the morning, speeding up work of greasing tractor and scraper wheels.

7th—They provide an extra man for an emergency.

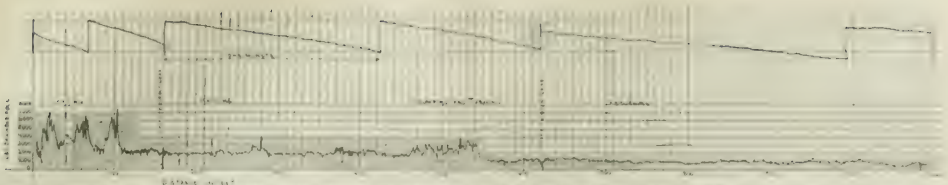
8th—They cost little. With dirt paid at the prevailing rate, and the extra operator getting $3, a few more yards of dirt pays his daily salary.

The road is about 24 feet wide, which gives ample room for passing at any point. The tractors turn the scrapers easily within this radius, and when necessary can turn within 18 or 20 feet. In going over or turning on soft fills, up grade, or through mud, the tractors have ample power to pull the scrapers. In fact, Mr. Mitchell handles all of his tractor operations on direct gear, rarely if ever using low gear of the tractor, which gives approximately twice as much power.

After a rain, operations can be resumed very quickly on account of the track laying construction of the "caterpillars," which gives them a firm footing over soft ground. A thin cut is made to take off the top layer of mud. The sub-soil then encountered is dry, and there are no further difficulties. Plowing is unnecessary except in one or two cases; when making deep cuts of from 7 to 10 feet, it is sometimes necessary to plow through the very hard clay found at this depth.

Before starting work on any particular section, the stakes are taken out and set on one side of the road. Particular attention is paid to getting down to grade on the crown; the sides being later finished with an 8-foot blade grader pulled by one of the tractors.

Mr. Mitchell has found that his four teams are particularly useful in smoothing out the road ahead of his wheel scrapers. For example, on coming to a gully some 30 feet wide with nearly perpendicular banks about 8 feet high that crossed the right-of-way, he worked his teams with slip scrapers all day, filling in the bottom and plowing the banks down somewhat. When he had made roughly a 25 per cent grade out of the banks, he moved his teams up farther ahead



DYNAMOMETER TEST OF MANEY FOUR-WHEEL SCRAPERS, THREE DRAWN BY 5-TON CATERPILLAR TRACTOR. MADE IN MEDIUM DAMP CLAY SOIL AT PEORIA, ILL., FEBRUARY 15, 1921, BY A. R. SQUYER, RESEARCH ENGINEER.

and put his tractors and scrapers to work on the fill. As the two outfits dump four full yards on every trip, the remainder of the fill was made in a short time. Such obstacles as trees, hedges, stumps and heavy roots are either dragged out by the tractors or chopped out by hand.

The contractor is doing his own concrete work and is using a small one-bag mixer for this, a foreman and five laborers being employed in this work.

EQUIPMENT AND PERSONNEL

The total equipment employed on this job is as follows:

Two 5-ton "caterpillar" tractors, 4 Maney four-wheel scrapers, 4 No. 2 slip scrapers, 1 plow, 1 blade grader (8 ft.), 1 Dodge touring car, 1 International truck, 1 concrete mixer (1 bag), 75 feet of chain and small tools.

The personnel is: 1 contractor, 2 tractor operators, 4 scraper operators, 4 mule team drivers (hired with teams), 1 dump man, 1 roustabout, 1 man for clearing right-of-way, 1 loader (for teams), 1 truck driver, 1 concrete mixer foreman, and 5 laborers on mixer.

Below is given a table of capacities showing amount of dirt the 5-ton "caterpillar" has moved daily, hauling 2 and 3 Maney scrapers, respectively:

The above calculations are based on round trip times, including over 15 per cent for lost time, or more than 1½ hours per day. The table was made from operations run under average conditions on level ground, and shows results that may be expected if the outfit is efficiently handled.

Below is shown dynomometer record of a 5-ton "caterpillar" pulling 3 Maney four-wheel scrapers, which was taken February 15, 1921, through a rolling field, soil, medium damp clay; showing all phases of operation within drawbar horsepower of the tractor.

Pounds Pull on Draw Bar

	Maximum*	Average	
Loading 1st scraper	6200	4960	at 1½ miles per hr.
Loading 2d scraper	5800	4520	at 1½ miles per hr.
Loading 3d scraper	6000	4800	at 1½ miles per hr.
Hauling loaded scrapers:			
Maximum		2800	at 3 miles per hr.
Minimum		1600	at 3 miles per hr.
Average		2140	at 3 miles per hr.
Dumping:			
Maximum		3100	at 3 miles per hr.
Minimum		1800	at 3 miles per hr.
Average		2540	at 3 miles per hr.
Turning empty:			
Maximum		1360	at 3 miles per hr.
Minimum		960	at 3 miles per hr.
Average		1160	at 3 miles per hr.
Returning:			
Maximum		1500	at 5.71 miles per hr.
Minimum		500	at 5.71 miles per hr.
Average		928	at 5.71 miles per hr.

*NOTE.—The pounds pull on draw bar required to load first scraper is higher than that required to load second and third, because scraper operator took an extra deep bite with his pan and took up a load greater than one cubic yard.

Detail Time Table for 5-Ton "Caterpillar" Pulling Two 4-Wheeled Scrapers.

Length of haul in feet	300	600	900	1320	1800	2640
Round trip time	3 min. 55 sec.	5 min. 35 sec.	7 min. 25 sec.	9 min. 50 sec.	12 min. 25 sec.	17 min. 25 sec.
Cubic yards per trip	2	2	2	2	2	2
Cubic yards per 10-hr. day	262	214	160	122	96	68

Detail Time Table for 5-Ton "Caterpillar" Pulling Three 4-Wheeled Scrapers

Length of haul in feet	300	600	900	1320	1800	2640
Round trip time	4 min. 45 sec.	6 min. 10 sec.	8 min. 10 sec.	10 min. 35 sec.	13 min. 20 sec.	18 min. 10 sec.
Cubic yards per trip	3	3	3	3	3	3
Cubic yards per 10-hr. day	360	270	210	150	120	90

BOTH OUTFITS ON THE FILL

From costs on four months' time already put in on the contract, Mr. Mitchell figures that his tractor outfit shows him a saving of from 20 to 25 per cent over the cost of doing the same work with teams.

Vehicular Tunnel Commission Retires Its Consulting Engineers

The New Jersey Interstate Bridge and Tunnel Commission has announced through its chairman, T. Albeus Adams, that it had dismissed its entire staff of consulting engineers, comprising Col. William J. Wilgus, Major John A. Bensel, Professor William H. Burr, Edward A. Byrne, J. Vipond Davies and Col. George Watson.

The commission has for several weeks been unable to agree with the New York Commission on the proposed widening of Jersey City streets for entrance and plaza purposes and, in discussing the commission's action Mr. Adams said: "The New Jersey commission is obliged to dispense with the services of the consulting board as at present constituted, because of the conviction, forced upon it by recent events, that some members of the consulting board have not been as unbiased and impartial in their relations with the respective tunnel commissions as the nature and purpose of the board's employment require. Believing that the employment of a joint consulting board, for this reason, has proved unworkable, as it certainly has been unsatisfactory, the New Jersey commission has determined to obtain its own technical consultants, and trusts that the New York commission will do likewise."

General Wage Reduction

A review of reports throughout the United States indicate that in the 19 states from which reports are available there were about 2,000,000 men unemployed May 1, a large proportion of them in the industrial section of the eastern and central states. Reports from the other 29 states from which complete figures are not available indicate that the unemployment there will bring the total in the country up to at least 3,000,000.

There is throughout the country a general tendency for the reduction of wages, that is, of course, considerably facilitated by the unemployment, although in the east there is a general feeling on the part of labor that the peak of unemployment has been reached and a spirit of resistance to the cut. Action of the railroad board and the steel industry insure reduction in very large interests that will, of course, greatly strengthen the movement throughout the country. Strong resistance to the absolutely necessary cut in the wages of marine workers has led to a serious walk-out or strike that was anticipated by the United States Marine Board and the Standard Oil Company, both of which expect to be able to operate a considerable part of their fleets by seamen, engineers and captains recruited from the unemployed or from qualified men working at present in other capacities.

In the west, south and central states, wage cuts have already been effected in a number of important factories. In New England the wages of printers and street railway employees have been reduced simultaneously with rates.

In Boston 16,000 men are idle in the building trade and several other cities announce an intended cut of 20 per cent in wages. In New York State the traction companies and builders will cut wages. In Pennsylvania wages in many cases have been cut but those in the coal industry have been maintained because of agreements having another year to run. Workers in shipyards have accepted a reduction of 10 per cent. In Illinois there are fewer strikes than usual and labor leaders are reported as fearing lock-outs by manufacturers. In North Dakota farm wages will be cut 35 per cent this season. In Iowa about 60 per cent of the 30,000 normally employed in the building trade are idle.

Statistics published by the United States Department of Labor show that in 14 important industries the pay rolls for March, 1921, were much less than for March, 1920. In the iron and steel works the decrease is 44.2 per cent. None of the other decreases is directly related to building and construction interests. The decreases are partly due to smaller forces employed, and partly due to lower wages.

Federal Aid Highway Construction

The Chamber of Commerce of the United States, in convention at Atlantic City, gave serious consideration to the highway situation, and resolved that: In order that funds now to be spent for highway construction may adequately serve the economic purposes which are becoming clearly recognized, bonds should be issued by states and territories, counties or municipalities, and federal assistance furnished, only for portions of highway construction which are reasonably enduring and permanent in character.

Federal appropriations should be made only for assistance to state highways which will become a part of an interstate system.

Federal assistance should be continued only to those states which adequately maintain highways for which there has been federal aid.

Most careful study should be made by the federal government in co-operation with state governments as to routes, the probable character of service over such routes, and the best form of construction to meet such service. These studies should include ultimate economies of location and design.

Obtaining Bonds by Misrepresentation

An amendment to Chapter 306 of the New York State Penal Code has been enacted to make larceny include obtaining surety bonds by false financial statements. The pest of the contracting business has long been the "shoe-string" gambler who camouflages insufficient assets behind big surety bonds, obtained through misrepresentation. Hereafter, in New York State, this practice will be punishable "by imprisonment for not more than one year or by a fine of not more than one thousand dollars, or both."

PUBLIC WORKS

Published Weekly
by
Municipal Journal and Engineer, Inc
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba....$3.00 per year
All other countries .....$4.00 per year

Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office, Monadnock Block, Chicago

A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

CONTENTS

LAYING REINFORCED CONCRETE SEWERS IN BRONX BOROUGH, NEW YORK—Illustrated.. 403

Court Powerless to Compel Sewerage 405

GRADING ROAD WITH TRACTORS AND WHEEL SCRAPERS—Illustrated. By W. B. Hill, Jr. 406

Vehicular Tunnel Commission Retires Its Consulting Engineers 408

General Wage Reduction 408

Federal Aid Highway Construction 408

Obtaining Bonds by Misrepresentation 408

EDITORIAL NOTES 409
Public Works Booming—Garbage Reduction Uncertainties

Street Cleaning by Philadelphia 410

BOOSTING A WATER WORKS INTAKE 410

Equitable Pay for Federal Employees 411

Loading Test on a Bridge Foundation Pile..... 411

Bituminous Paving for Japan 411

WORK DONE DURING 1920 AND CONTEMPLATED DURING 1921—Table 412

HOW CAN A BRICK BUILDING WITH FOUNDATIONS ON WET SAND BE UNDERPINNED? 415

Philadelphia's Big Paving Program 417

Public Works Booming

In spite of the hesitation of some public officials to begin construction work at the present time, the past month has shown that these are apparently in the minority and that a great many cities, counties and states believe it wise to contract at once for public works of various kinds.

PUBLIC WORKS collects data concerning contracts let throughout the country. While our records are probably more complete than any others collected, undoubtedly quite a number of contracts are let concerning which we receive no information. Also, no attention is paid to contracts of less than $5,000 or $10,000, and there are a great many smaller than this. It is possible, therefore, that our figures should be increased by 25 per cent to 50 per cent to represent the total for the entire country. As an illustration of the tendency of the time we may give the figures for the four weeks ending April 30. A great part of the work is that connected with streets and roads, water supply, sewerage and sewage disposal, and bridges, and including these items alone, during the week ending April 9 our records showed contracts awarded amounting to $22,770,357. The following week the total was $22,510,905. The third week it was $25,331,057, and the fourth week the total was $34,694,006. This gives a total for the four weeks of more than $105,000,000, and for reasons stated above it is possible that the totals of the contracts let during that period will approximate $140,000,000.

Considering the classes of work contracted for, we find the totals for street and road work for the four weeks in question were $72,297,406; the water supply contracts totaled $9,161,363; the sewerage and sanitation work, $15,141,466; and the total for bridges was $8,726,090.

Dividing the total for each class by the number of contracts for that class in order to obtain the average size of the contracts under each head, we find that the average of the four weeks for street and road work was $113,319; for water supply, $81,074; for sewerage and sanitation, $98,964; and for bridges the average was $70,371.

While these figures seem large, they merely indicate a beginning of the season rather than the peak of it. For instance, they include something under $85,000,000 worth of street and road work, whereas there is known to be more than ten times this amount of work ready to be let for this season. The same is probably true of work connected with water supply systems, sewerage and bridges.

It is known that there is billions of dollars' worth of public work waiting to be done, and in most cases those in charge are ready to let the contract if they believe they can get reasonable prices. It would therefore seem to be up to the dealers in materials and to labor, and to contractors who must base their bids upon these, to make prices that will be acceptable to the public officials; and if they do so, all will find themselves with as much business on their hands as they can possibly undertake during the building season.

Garbage Reduction Uncertainties

Two or three years ago cities and private companies utilizing the saleable portions of garbage by means of reduction plants were making a profit if such is ever possible, as they were receiving unprecedentedly high prices for the grease and tankage sold. For instance, in 1918 the Philadelphia price of grease was as high as 11½ cents a pound and tankage was $11 a ton.

Since the war, however, prices of both of these have fallen and a few weeks ago the market price of garbage grease was 2¾ cents a pound and that of tankage was $5 a ton. Some report even lower prices. For instance, in a letter to the mayor of Boston in which it was asking relief from its contract with the city for disposing of the city's

garbage, the president of the Boston Development and Sanitary Company wrote: "The best offer that I could obtain last week for our grease was 2 cents a pound. The cost of manufacturing is 7½ cents a pound, inclusive of overhead, insurance, depreciation and maintenance. Tankage can no longer be manufactured as there is absolutely no market, all fertilizer manufacturers' store-houses being filled."

Even though the situation may not generally be as dark as this, those who are considering the adoption of reduction as a means of disposing of sewage should not be misled by reference to prices received in the past, but should realize that in the future they cannot expect to receive more than 20 per cent to 50 per cent of the high prices of war time. Operating costs of course have diminished also, but not in proportion to the decrease in the prices obtainable for reduction products.

Grease at 2 cents a pound and allowing 50 pounds per ton, and tankage at $5 per ton and allowing 200 pounds of tankage per ton of garbage would give a return of $1.50 per ton of garbage treated in a reduction plant. These are perhaps lower prices than can be obtainable at present, although higher than it was claimed by the Boston company that it could obtain; but not very much lower than several plants were receiving the early part of this year, and probably not lower than should be figured on in estimating the financial features of a proposed reduction plant. Either operation alone, or interest, depreciation, insurance and other fixed charges alone, would probably exceed this amount. If these figures are even approximately correct, the reduction process largely loses its attractiveness as a means of securing revenue from garbage disposal, or even of greatly reducing its cost.

Street Cleaning by Philadelphia

Since the first of the year, Philadelphia has been cleaning two of its street cleaning districts by municipal forces, as stated in our issue of January 22, 1921. Officials of the highway bureau are reported as saying that there is no question that streets in these two districts are cleaner than they have been for many years and also that this has had its effect on the contractors who are cleaning the other districts so that the city as a whole is better cleaned than it was when contractors were doing all of the street cleaning. Chief Fred. C. Dunlap and J. H. Meeson, principal assistant engineer in charge of street cleaning, state positively that the municipal cleaning also costs less than that done by contract. Bids for cleaning these two districts amounted to $1,485,668. The city appropriated $1,285,000 for cleaning the same districts and the officials say that they can keep within that figure, notwithstanding that the pay of the block men has been increased over that paid by the contractors and that it was necessary for the municipality to organize an entirely new force, obtain equipment and develop a new organization.

One of the advantages of municipal cleaning is shown by the fact that this year, with an early spring, night cleaning in the central section of the city was started a month earlier than was customary under the contract system, or probably than it would have been had a contract been in force fixing the date on which such cleaning should begin.

The Philadelphia officials find, as do those of other cities, that one of the greatest difficulties in keeping streets clean is the failure of co-operation by the citizens, who continually throw on them rubbish of all kinds, from matches to ashes, and especially paper of various kinds.

Boosting a Water Works Intake

The use of a booster pump between the intake crib of a water works plant and the main pumping plant is an unusual construction which was adopted by Geneva, Switzerland, as described by Monsieur A. Betant, engineer of the Geneva water works, in a paper presented to the New England Water Works Association through Professor George C. Whipple.

The city, which has a population of about 148,000, is supplied with unfiltered water from Lake Geneva. The water enters through an intake crib in about 49 feet of water at a distance of 1.55 miles from the harbor jetties and 0.8 mile from the shore immediately opposite. From the intake crib to the pumping station the water flows through a 48-inch pipe 12,000 feet long, laid on the bottom of the lake and of the Rhone river on which the pumping station is located. The water is pumped by means of hydraulic turbines of 3,000 horsepower capacity, power being supplied by the river Rhone.

Up to a few years ago, water flowed by gravity to the pumping station, the intake pipe having a capacity of between 13.7 and 18.3 million gallons a day. In 1913 it became necessary, because of the increase in water consumption, to enlarge the capacity of the conduit to 25.2 million gallons a day. Instead of laying a larger or a supplementary conduit, this increase in delivery was accomplished by installing an electrically operated centrifugal pump in the line of the intake conduit, at a point where the bottom of the lake is 13 feet below the surface. The pumps located at this point not only increase the discharge of the conduit to the main pumping plant, but, by placing this section of the conduit under pressure, prohibit the access through any leaking joint in the conduit of the water of the Rhone river, which is considerably more impure than that of the lake at the intake crib.

In installing this booster plant, a sheet iron caisson 23 feet in diameter at the base was constructed on shore and floated to the pump site and there sunk by filling it with concrete, until it rested on the level bottom of the lake. It was then secured by 16 anchor piles driven around the circumference. The caisson was placed about 50 feet to one side of the intake conduit. In con-

creting the caisson, a central chamber was left and in this a pump and motor were mounted, direct connected by a vertical shaft, the pump having a capacity of about 25 million gallons per day against a head of 10 feet at 200 r. p. m. After sinking the caisson, a 33-foot section of the conduit directly opposite the caisson was replaced by two special castings containing "Y" branches, a check valve being inserted between them, which permitted the pressure to adjust itself automatically when the pump was started; these branches being connected to the suction and discharge of the pump by means of 36-inch cast iron pipes passing through the wall of the caisson.

Electricity for operating the pump is provided by a special generator at the hydro-electric station, an independent cable connecting this with the booster pump. The pump is therefore under entire control from the station and it is not necessary to visit it oftener than once a month, when the pump and motor are oiled. This installation has been in regular operation since June, 1914.

Equitable Pay for Federal Employees

Employees in the various departments of the United States government, including the engineers in various bureaus by which public works are executed, feel considerable satisfaction over a recent committee report of the Chamber of Commerce of the United States, recommending "adequate and equitable pay for the army of more than half a million government employees as one of the series of proposals for the complete recasting of the federal civil service." Some time ago the National Federation of Federal Employees made recommendations along these lines and the president of that federation, Luther C. Steward, expresses gratification that the recommendation of the Chamber of Commerce of the United States is identical in eight of its nine points with the reclassification program advocated by the federation.

The committee of the Chamber of Commerce on April 24 sent the recommendation referred to to a referendum vote of the 1,400 industrial and commercial organizations in its membership. The recommendations to be voted on are as follows:

I. The present system under which personnel for the federal civil service is secured and managed should be recast.

II. Adequate and uniform pay under essentially like conditions should be established as a fundamental principle for the federal civil service through reclassification and regrading.

III. Reclassification should be by statute based on investigations already made and further investigation by the Civil Service Commission.

IV. Reclassification should be installed by the Civil Service Commission and the Budget Bureau and current correction made by Congress aided by these agencies.

V. Promotion should be given statutory recognition as the preferred method for filling vacancies, with lines of promotion clearly defined and promotions made upon the basis of proved merit under civil service regulations.

VI. All administrative officers not responsible for determining policies should be included under civil service rules.

VII. Transfers between departments should be regulated by executive orders consistent with the civil service law.

VIII. Efficiency records should be developed by the Civil Service Commission.

IX. Removal of an employee should be possible upon a written statement of reasons to the employee with opportunity for written reply, but without right of appeal above the head of the department.

Loading Test on a Bridge Foundation Pile

The bridge carrying Black street, Hamilton, Ohio, across the Miami river, has seven 93-foot concrete arch spans supported on concrete piers with pile foundations about 16 feet below the river bed. The 24 x 62-foot footings are supported by 150 20-foot wooden piles spaced 3 feet apart in each direction and driven to a penetration of 18 feet in sand and gravel by a 3,800-pound No. 3 Vulcan steam hammer operated in leads swung from the 70-foot boom of a Bucyrus drag-line caterpillar excavating machine.

One of the piles, 8 inches in diameter at the butt and 19 feet long, was driven to a penetration of 16 feet and to a refusal of ⅓ inch under the last blow of the hammer. It was subjected for three days to a test load of 30 tons of pig iron which produced only ¾-inch ultimate compression and settlement.

The top of the pile was sawed off horizontally about 3 feet above the bottom of the excavation and was capped with a steel plate affording bearing for a 12 x 12-inch horizontal timber 7 feet long supporting the 7 x 7-foot loading platform knee braced to the pile. The platform was additionally supported by temporary jack screws until the pig iron had been piled on it, when the jack screws were released, transferring the entire load to the pile and producing some compression in the timber of the platform and of the pile which was included in the ¾-inch platform settlement recorded.

Bituminous Paving for Japan

Professor T. Takakuwa, of Kiriu University, Tokio, Japan, a commissioner for the Japanese government, who has spent more than a year investigating street improvements in America and Europe, is now on his way across the United States with the expectation of reaching Japan within the next few weeks. He states as his opinion that asphalt should be adopted very largely for paving the streets and roads of his country.

Several years ago some asphalt pavement was laid in Tokio, but in a ridiculously primitive manner and without any mechanical equipment, and naturally proved to be a failure. Many engineers in Japan are in favor of wood block pavement. However, although there is considerable timber in the country, it is being used up at about double the rate at which it is being grown. Professor Takakuwa expects to recommend the adoption of bituminous pavement and laying it by means of modern equipment, such as is used in the United States. It is expected that Tokio will begin laying new pavements throughout the city before summer of this year and that Osaka and other of the principal cities will begin paving in the immediate future, possibly this year.

WORK DONE DURING 1920 AND CONTEMPLATED DURING 1921 (Continued)

County and State	During 1920: Money spent for hwy. work	During 1920: Kind and amount of surface laid	During 1920: Amt. done by contract & by employees C—contract E—employees	During 1921: Money available for hwy. wk.	During 1921: Kind & amt. of surface to be laid	During 1921: Amount to be done by contract and by employees C—contract; E—employees
Minnesota (continued):						
Jackson	$204,000	20 gravel	all E	$200,000	11 grading, 20 gravel	all E
Kandiyohi	350,000	4 conc., 15 grading, 20 gravel	grad. & grav. E pavement C	185,000	2 conc., 20 grading, 20 gravel	2 conc. C, rest E
Lac Qui Parle	360,000	73 gravel, 22 graded	all grading, 35 gravel E, 48 gravel C	220,000	50 grading	all E
Lincoln	62,855.75	7 gravel	all C	70,000	12 grading	¾ E, rest C
Lyon	292,115.85	21 grading, 21.44 gravel	grad. & maint. E grav., bdgs., etc., C	325,000	18½ graveling, 25 grad'g, br. & culvt.	grading E, rest C
Marshall	400,000	240,000 gravel, 140,000 earth	all C	.....	$250,000 gravel, $150,000 earth	all C
McLeod	120,925.45	14 gravel	all C	80,000	8.5 grading, 14 gravel	10 gravel E, rest C
Millelacs	566,993.44	43,000 cu. yds. gra.	10,000 cu.yds.E 33,000 C	135,000	.....	all C
Nicollet	65,866.77	6 gravel	all E	90,000	8 dirt	all C
Nobles	514,000	6 conc., 15 gravel, 30 grad.	8 gravel E rest C	.....	20 grading, 20 gravel	all C
Pope	200,000	16 gravel, 8 grade	grade E grade & gravel C	120,000	3½ F.A.P., 6 grading	.....
Redwood	213,942.27	48 gravel	60% E 40% C	195,000	40 graveling	50% E, 50% C
Roseau	187,744.32	1.1 gravel	$2,032.51 E 16,701.81 C	110,000	14 gravel, 4 earth	all C
Stearns	150,000	10,000 gravel	all E	150,000	10,000 clay sand, 15,000 gravel	all E
Steele	60,962	4 grading, 2½ gravel	gravel E grading C	142,000	17 grading & gravel'g	graveling E, grading C
Stevens	337,493.36	4.499 cem. conc., 15.04 gravel, 18 earth	all C	.....	5.501 cem. conc., 2 graveling & grading, 12 earth	2 gravel E, rest C
Swift	342,199.62	6 conc., 16 grav., 8 dirt	4 grav., 8 dirt E 12 grav., 6 con. C	50,000	maint. & repair	all E
Wadena	40,000	.....	30,000 E 10,000 C	85,000	1-2 sand clay	most E
Winona	150,000	all grading	50% E 50% C	200,000	5 conc., 150 maint.	maint. E, rest C
Mississippi:						
Adams	98,000	3.6 gravel surface	all C	250,000	12 gravel surface	all C
Benton	.....	11.8 left from 1919	....	350,000	11.8 gravel, 30 graded earth	all C
Harrison	.....	2,582 war.-bit.	....	.....	.....	.....
Lafayette	.....	small amts.	all E	150,000	80 grading & surfacing with sand clay	all C
Lincoln	[illegible]000	52,700 conc. bridges rest gravel	50,000 E 82,000 C	30,000	10,000 gravel, 20,000 conc. bridge	gravel E, bridge C
Lowndes	100,000	mac.	all C	50,000	mac.	all C
Missouri:						
Butler	50,000	repair & maint.	all E	250,000	2 fed. aid projects	all E
Caldwell	120,000	grading, bridges	all E	150,000	grading, bridges	90,000 E, 60,000 C
Carter	40 000	dirt	all E	60,000	19 dirt	Indef.
Cedar	.....	dirt	all E	100,000	.....	some C
Clark	45,000	dirt	grading E bridges C	75,000	14 dirt, 10 gravel	all C
Cooper	75,000	brick, conc., bit.	all C	150,000	bit. mac., brick, tarv.	all C
Henry	60,000	earth, maint.	all E	150,000	28 earth, 14 gravel	all C
Lincoln	37,200	10,000 culvts. & bridges	all E	.....	.....	.....
Macon	20,000 to 35,000	none	none	60,000	hard surfacing	all C
Mississippi	166,000	5½ conc.	all C	456,000	9.8 conc., 6.93 conc. & gravel shoulders	all C
Monroe	52,000	100 graded earth	175 E	160,000	7½ gravel, rest earth	20,000 E, 110,000 C
Ozark	5 000	none	40 C, rest E	80,000	20 binding	all C
Perry	18,000	3 rock & gravel	all E	24,000	rock & gravel	all E
Putnam	none	none	none	60,000	10 grading & bridg'g	all C
Ralls	39,754.42	252 graded	all E	60,000	2.6 finishing to grade, 11 grading, 2 grav.	all C
Schuyler	38 170	none	all E	none	none	.....
St. Clair	48,747.73	dirt	all E	50,000	.....	.....
St. Louis	.....	30 805 war.-bit.	....	.....	.....	.....
Sullivan	40,000	graded earth & bridges	state work C rest E	25,000	earth, $14,000 bridges	bridge E, state work C
Montana:						
Beaverhead	62 000	4 mac., 10 earth	2 grading C rest E	30,000	.....	all E
Big Horn	125 000	4 grav., 25 dirt, maint.	all E	110,000	maint., culvts.&brdgs.	bridges C, rest E
Blaine	350,000	27 gravel, 20 dirt	dirt E gravel C	none	none	.....
Carbon	200 000	19 gravel, 20 earth	all E	50,000	maint., drnge. struct.	all E
Chouteau	85 000	earth roads	60,000 E 25,000 C	55,000	regrading earth	all E
Fergus	450,000	130 earth, 3 grav. ½ con.	all C	300,000	60 earth, 5 gravel, ¾ conc.	all C
Flathead	215 000	14 gravel	all E	60,000	maint.	all E
Granite	90,000	8 grading, 4 gravel, $20 000 maint.	all E	200,000	11 regrading & grav.	all C
Hill	175,000	50,000 dirt, 100,000 gravel	125,000 E 50,000 C	200,000	50,000 dirt, 150,000 gravel	all E
Madison	90,102.93	culverts, maint.	all E	50,000	.....	all E
Meagher	160 000	44 grading, 5 earth 5 gravel, earth	20,000 E 140,000 C	60,000	Fed. Aid Proj.	all C
Musselshell	393 865.50	dirt	75% C, rest E	12,000	finish wk. under way	all C
Prairie	25 000	22 earth, 3½ gravel	large fills C rest E	30,000	30 grade, 5 gravel	large fills C, rest of work E
Stillwater	198,000	1 gravel, rest dirt	80,000 E 118 000 C	116,000	const. & maint.	41,000 C 75,000 E
Teton	183,000	23 gravel	all C	165,000	16 gravel	all C
Valley	78 000	2 fed. aid gravel	all E	50,000	10 gravel	all E

WORK DONE DURING 1920 AND CONTEMPLATED DURING 1921 (Continued)

County and State	During 1920: Money spent for hwy. work	During 1920: Kind and amount of surface laid	During 1920: Amt done by contract & by employees C—contract E—employees	During 1921: Money avail. also for hwy. wk.	During 1921: Kind & amt. of surface to be laid	[illegible]
Montana (continued):						
Wheatland	50,000	earth	28,000 E 22,000 C	50,000	40,000 earth	[illegible]
Yellowstone	250,000	2 [illegible] inc., 20 gravel	1 gravel E rest C	350,000	300,000 fed. aid	[illegible]
Nebraska:						
Antelope	50,000	clay & gravel	all E	175,000	40 dirt	[illegible]
Dakota	[illegible]	earth grading	all E	60,000	grading	[illegible]
Deuel	14,000	[illegible]	$50,000 E, 11 C	8,000	grading	[illegible]
Dodge	40,999.68	[illegible] patrol of roads	[illegible]	[illegible]	[illegible]	[illegible]
Hooker	25,000	sand clay	all E	50,000	sand clay & gravel	all E
Knox	200,000	62 earth, 2 gravel	45 grading E 18 C	75,000	5 gravel, 5 clay, mnt.	all E
Morrill	60,000	gravel, magnesia	16 E, 10 C	50,000	30	40 E, [illegible] C
Otoe	219,173.15	earth roads	115,000 E 104,173 C	285,000	40 earth, 400 grading	grading E, br. E, earth & br. C
Rock	10,000	dirt	all E	10,000	[illegible]	all E
Saline	54,140	earth	32,140 E 22,000 C	50,000	earth	50 E, [illegible] C
Sherman	70,000	soil surface roads	60,000 C	50,000	dirt	all E 50,000 E, 50,000 C
Wayne	35,000	earth	all E	100,000	[illegible]	[illegible]
New Jersey:						
Atlantic	[illegible]	7,333 war.-bit.	[illegible]	[illegible]	[illegible]	[illegible]
Burlington	800,000	17 sheet asphalt	all C	550,000	10 sh. asp., 1 conc.	all C
Cumberland	100,000	10 gravel	2 C, rest E	650,000	9 conc., 5 gravel	gravel E, [illegible] C
Essex	[illegible]	29,581 war.-bit.	[illegible]	[illegible]	[illegible]	[illegible]
Hunterdon	150,000	5 pen. mac., 45 mac.	all C	200,000	2 pen. mac., 4 asp. conc., 6 mac., 65 maint.	mac., [illegible] C
Mercer	531,200	1½ sh. asp., ½ brick, ½ conc., 5 mac.	all C	350,000	4 sh. asp., 2 pen. mac.	all C
Middlesex	[illegible]	14,970 war.-bit.	[illegible]	[illegible]	[illegible]	[illegible]
Monmouth	[illegible]	2,888 war.-bit.	[illegible]	[illegible]	[illegible]	[illegible]
Morris	[illegible]	7,979 war.-bit.	[illegible]	[illegible]	[illegible]	[illegible]
Passaic	434,000	12,524 sq. yds. asp., 8,640 conc., 7,027 [illegible] sq., 5,718 amesite, 10,670 brick, 7,840 war., 2,520 conc., 8,182 granite	all C	385,000	sh. asp. conc., mac., warrenite, amesite	all C
Southern Div.	1,188,000	20 conc.	all C	[illegible]	20 conc., 15 gravel	all C
Sussex	250,000	7 gravel, 6 bit. mac.	gravel E mac. C	445,000	3.4 grading, 10.5 grad. & graveling	$[illegible] E, $[illegible] C
Union	150,000	[illegible]	10,000 E, 140,000 C	600,000	6½ conc. conc., 2½ bit. conc.	repairs E, rest C
New York:						
Broome	386,267	9.96 conc., 2½ asp. mac.	all C	175,000	[illegible]	all E
Cayuga	343,173	7 conc., 20 mac.	5 C, rest E	735,000	15 bit. mac., 5 mac.	state wk. C, rest E
Chemung	667,000	1 conc., 1 bit. mac.	10 E, 14 C	1,200,000	13 conc., 25 bit. mac.	16 E, 18 C
Franklin	500,000	mi[illegible] & repairs	all E	500,000	maint. & repairs	all E
Jefferson	500,000	[illegible] bit. mac.	maint. E const. C	$80,000	35 bit. mac., 5 conc.	all C
Madison	200,000	15 mac.	10 E, 5 C	450,000	6 conc., 19 mac.	15 E, 10 C
Monroe	1,004,128	22 mac., 5 gravel	all E	426,681	30 mac., 7 gravel	all E
Nassau	1,241,600	concrete	all C	750,000	733,600 conc., 17,000 mac.	all C
Niagara	400,000	8 conc., 3 bit. mac., 20 w. b. & stone	wb & stone E rest C	750,000	24 conc., 20 bit. mac., 16 w. b. & stone	16 E, 44 C
Orleans	35,000	concrete	all C	140,000	4 conc.	all C
Oswego	510,000	16 mac., 10 asp. pen.	16 E 10 C	650,000	25 mac., 18 asp. pen.	25 E, 18 C
Otsego	385,000	12.62 mac., 1 grading, 6 conc. [illegible]	4 E 18.62 C	250,000	3.5 conc., 4 mac., 8 conc. possibly	4 E, 3.5 C
Yates	166,141	9.62 mac.	all E	150,000	[illegible]	108,000 C
North Carolina:						
Beaufort	400,000	5 sheet asp., 5 war	all C	400,000	4 war., 1 conc. 10 un-certain	all C
Buncombe	250,000	conc. asp., sand clay	50[illegible] E	250,000	20 conc., 10 sand clay	snd. clay E, asp. C
Craven	100,000	8 brick, 10 dirt	dirt E brick C	none	[illegible]	[illegible]
Durham	199,714.62	21,680 sq. yds. gravel, 91,721 bit.	gravel E bit. C	300,000	40 mac.	all C
Guilford	[illegible]	42,843 war.-bit.	[illegible]	[illegible]	[illegible]	[illegible]
Lenoir	650,000	concrete	all C	950,000	same as 1920	all C
Mitchell	200,000	grading	all C	350,000	4 [illegible] surfacing	all C
Randolph	75,000	50 gravel & topsoil	62,000 const. & amount E Fed. aid C	[illegible]	[illegible]	50,000-75,000 E 21 fed. aid C
Wake	[illegible]	74,194 war.-bit.	[illegible]	[illegible]	[illegible]	[illegible]
Washington	51,000	5 sand clay	all E	[illegible]	[illegible]	[illegible]
Watauga	30,000	dirt	all E	75,000	9.19 gravel	all C
Wayne	131,206.98	$91,665.86 sand clay gravel surface	all E	[illegible]	20 sand clay, hard surface	sand clay E
Wilkes	200,000	1 cement, 50 topsoil	all E	300,000	[illegible]	all E
Wilson	56,000	25 sand clay & grav.	all E	120,000	73½ gravel, 6½ sand clay	all E
Yancey	130,000	16 grading, 3 bridges	all E	30,000	[illegible]	[illegible]
North Dakota:						
Barnes	150,000	[illegible]	all C	70,000	[illegible]	all C
Grand Forks	57,826.72	6 gravel	all E	150,000	1 conc., 17 gravel, 40 dirt	½ E, ½ C
Grant	75,000	3 gravel, rest earth	50% E 50% C	78,000	25 earth	15 E, 10 C
McIntosh	30,000	dirt	3,000 E, 27,000 C	40,000	[illegible]	practically all C
McKenzie	35,000	earth	all C	none	repairs	10,000 C
Mountail	75,000	dirt	120 grader work E 50 C	125,000	15 dirt	100 grader wk. E 75 C
Pembina	18,000	earth grade	all C	[illegible]	[illegible]	[illegible]

WORK DONE DURING 1920 AND CONTEMPLATED DURING 1921 (Continued)

County and State	During 1921: Money spent for hwy. work	During 1921: Kind and amount of surface laid	Amt. done by contract & by employees C—contract E—employes	During 1921: Money available for hwy. wk.	During 1921: Kind & amt. of surface to be laid	Amount to be done by contract and by employees C—contract; E—employees
North Dakota (continued):						
Pierce	45,000	5 clay, 10 gravel, earth	none E 25% C	45,000	30-40 gravel, 5 clay, earth	all C
Ward	123,587.45	6 gravel, 10 earth	2% E 98% C	150,000	25 gravel	20% E, 80% C
Ohio:						
Allen	50,000	10 mi. dump pike	a l C	610,000	21	15 C
Ashtabula	275,000	4 mac., 8 brick	all C	700,000	27 bit. mac., 15 brick	all C
Carroll	75,000	macadam	all C	400,000	15 bit. mac.	all C
Champaign	300,000	2½ concrete	all C	900,000	22 conc., 18¾ crushed stone	all C
Clark	133,000	maintenance	all E	805,000	19 conc.	all E
Clermont	250,000	macadam	25,000 E 225,000 C	360,000	mac.	all C
Clinton	135,000	none	....	450,000	8 conc., 4 rolled stone	all C
Columbiana	588,530	8.48 brick, 3.24 mac. 3.50 conc., 1.5 grading	all C	665,627	4.96 brick, 1.34 mac., 28.3 grading	all C
Coshocton	242,406.23	2 conc., 2.5 brick, 6 gravel	gravel E rest C	195,000	7.5 conc. or brick, 2.5 brick	$0,000 E 337,000 C
Darke	700,000	175,000 brick, 325,000 conc., 200,000 gravel	all C	1,250,000	22 brick or conc., 10 gravel	all C
Erie	400,000	mac., conc. & brick	100,000 E 250,000 C	1,000,000	mac., conc. & brick	150,000 E 850,000 C
Fairfield	165,000	2 3 gravel, 35 mac., maint.	75,000 E 90,000 C	400,000	5 brick or conc., 6 bit.	75,000 E
Fayette	335,000	mac.	all E	.....	10 mac.	all C
Fulton	353,000	mac.	252,000 C, rest E	391,000	13 conc., 8 mac.	21 C
Hamilton	....	$.891 war.-bit.		....		....
Henry	200,000	mac.	all C	340,000	7 mac., 4 conc.	all C
Highland	900,000	mac.	all C	500,000	$10,000 mac., 400,000 mac. or rock asp.	25,000 E 475,000 C
Holmes	72,259.15	4 5 gravel, 2.5 grade	2.4 gravel E rest C	486,000	6.25 brick, 5.45 conc., 1.75 mac., 4 gravel, 9.4 grade	2 gravel E, rest C
Jackson	....	.....	....	.....	6 mac. or conc.	.....
Jefferson	65,000	none	....	750,000	7 brick, 4 mac., 24 mac. surface	maint. E, rest C
Licking	286,841	242,117 conc., 44,726 pen.	all C	491,000	4 conc., 7 pen.	pen. maint. E rest C
Marion	350,000	6 bit.	150,000 E, 200,000 C	.....	22 bit. mac.	.....
Meigs	20,000	1.75 mac.	all E	300,000	22 mac.	all C
Ottawa	350,000	conc.	a l C	320,000	8 conc.	all C
Pickaway	.....	tar mac.	4 E, rest C	.....	12 gravel, 6 tar or brick	2 E, 16 C
Putnam	140,000	mac.	120,000 E, 20,000 C	518,000	21.5	surf. treating E, rest C
Richland	423	½ conc., 12.8 bit. mac., 5½ gravel	5.3 E 13.5 C	340,000	3½ brick, 5 bit. mac., 5 gravel	all C
Ross	60,060	1 brick	all C	none	1 brick	all C
Sandusky	815,000	11.5 brick, 1 conc., 12 mac.	all C	200,000	.5 brick, 3.5 conc., 12 mac.	all C
Summit	275,000	conc.	all C	1,000,000	24 conc.	all C
Trumbull	1,215,000	4 brick, 32 bit. mac.	all C	2,000,000	18 brick, 2 conc., 25 mac.	all C
Tuscarawas	100,000	1½ conc., 3½ mac., 5 dirt	10 C	500,000	8 brick, 6 conc., 8 bit. mac.	20 C
Union	100,000	mac.	all C	400,000	100 mac.	all C
Warren	210,000	none	118,136 C, rest E	.....	17½ mac.	all C
Williams	193,000	8 bit. mac.	all C	580,000	2 rock, 18 bit. mac., 6 gravel	all C
Oklahoma:						
Beckman	55,000	dirt	30,000 E, 25,000 C	50,000	5 gravel, 20 sand clay	10,000 E, 40,000 C
Bryan	100,000	dirt, bridges	....	1,400,000	80 gravel	all C
Carter	400,000	.....	....	550,000	26 gravel	almost all C
Choctau	95,000	30 dirt	all E	660,000	57 gravel	all C
Craig	38,000	grader work	a l E	52,000	none	.....
Dewey	47,200	dirt	all E	42,600	dirt	all E
Garfield	627,069	7 conc., 20 dirt	dirt E, rest C	300,000	dirt, brdgs. & culvts.	10% E, rest C
Grady	200,000	bridge		100,000	bridges	all C
Hughes	200,000	earth	all E	60,000	hard surfaced roads	all C
Kingfsher	208,006	1 conc., 2 sand clay, earth	1 conc C rest E	.....	1 conc., 3 sand clay	1 conc. C, rest E
Latimer	7,500	dirt	all E	47,500	fed. project	½ E
Leflore	90,000	dirt bridges	bridges C rest E	30,000	telford & burnt shale	½ E
Major	185,000	140,000 earth, $5,000 culverts & bridges	50% E 50% C	.....	earth	all C
Oklahoma	150,000	dirt	all E	150,000	13 conc. or asp.	dirt E, 13 C
Pottawatomie	402,500	earth	247,000 E 155,000 C	200,500	earth	150,000 E, 50,500 C
Oregon:						
Clatsop	.....	2,962 war.-bit.	....	.....	.....	.....
Columbia	.....	4,185 war.-bit.	....	.....	.....	.....
Hood River	.....	23,000 war.-bit.	....	.....	.....	.....
Jackson	....	8,000 war.-bit.	....	.....	.....	.....
Lake	75,000	gravel	3 [illegible]	60,000	to complete 3 hwys. now under constr., 8 state road	hwy. E, rest C
Lane	.....	16,000 war.-bit.	....	.....	.....	.....
Marion	800,000	20 asp., 100 grav. & mac	all E	800,000	25-30 asp., 75-100 gravel & mac.	600,000 E, state work C
Morrow	301,121.19	6 rock & gravel, earth	107,994.82 E 93,126.37 C	308,796.83	30 crushed rock	.....
Multnomah	605,574.29	1 grade, 10 gravel, 14 mac., 2 pavement	....	531,000	maint., grading, mac., gravel, paving, etc.	400,000 E, 131,000 C

(To Be Continued)

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems different will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

How Can a Brick Building with Foundations on Wet Sand Be Underpinned?

By sectional replacement without support: by replacing with temporary supports: by extension of original foundations: and by protecting existing footings.

It frequently happens that the stability of the exterior walls of a building are threatened through defects in the design, construction or endurance of their foundation; through heavier loading, vibrations, or through changed conditions inside or outside the building, especially the building of new structures close to the old building or the excavation of pits or trenches close to it below the bottoms of the old footings, or pile driving near them.

If the walls above the foundation are properly designed and in good condition the underpinning is easier for a wooden, steel or iron building. It is likely to present more difficulties and be slower and more expensive for a brick or stone wall.

The methods and operations vary a great deal with the character of the old footing and its location, the weight supported on it, the nature of the soil and underlying strata, condition of the building and the requirements for the new foundation, whether there is free access for the workmen and room for operations and equipment in the building itself and the outside space adjacent to the wall.

WITHOUT SUPPORTS

If the walls and footings are in good condition and the latter are seated on any hard, firm, dry soil and it is only necessary to enlarge the footings to give them a greater bearing surface on the soil or to carry them a few feet deeper to be below some adjacent excavation, the work is simple and easy, provided there are no restrictions to entering the lower story of the building and there is plenty of space there and in front of the wall for the execution of the work.

If the brick wall is in good condition and continuous and has no openings for a height of 8 to 10 feet above the footing it will be safe to excavate inside or outside the building, or both, adjacent and down to the bottom of the footing, and cut out full width sections of the latter about 4 feet long and 20 feet apart on centers. The wall will arch over the openings and require no temporary support or at the most only light boards to hold up bricks that may be loosened in the bottom courses. The openings and excavations can be made to the required width and depth of the new footing and the latter, usually of concrete, can be simultaneously built up to within about 2 feet of the underside of the old brickwork.

CONNECTING FOOTINGS TO WALL

Moderate size hard, sound stones with carefully dressed upper and lower surfaces can then be carefully bedded under the wall on top of the incompleted footings, pairs of steel plates placed on them separated by pairs of folding steel wedges and corresponding stones placed on the upper plates, reaching to the under side of the brickwork, where they are properly bedded with cement mortar the same as used for lower stones. The pairs of wedges can then be driven hard until the wall shows signs of displacement over them indicating that a large portion of the weight has been transferred through them to the new section of footing, after which the footing can be concreted up as high as possible and shimmed and grouted solid to the bottom of the brick wall.

After the completion of the first set of footings, a new set of holes can be put through the old footings midway between those of the first set, and the operations repeated, after which the footings in the spaces remaining between the old and new footings can be similarly removed and rebuilt thus eventually replacing the entire footing without ever having removed more than 20 per cent of the old total bearing on the ground.

Before commencing the work a careful survey of the building should be made and measurements and photographs taken of the walls, especially of the door and window openings and lintels or any incipient cracks which should be sealed with paper pasted over them, and accurate levels taken of the wall and repeated daily to detect any settlement or displacement. If any displacement is at any time observed the supports under the wall should be immediately supplemented by temporary jackscrews and blocking and braced, if necessary to prevent settlement. This precaution should always be taken if necessary with the various kinds of underpinning, hereafter described.

SHORING WITH NEEDLEBEAMS

If the ground is wet, soft, sandy or otherwise unstable the wall may require bracing or other temporary support while the underpinning is in progress, and the excavation for the new footing may require to be sheeted to prevent displacement of the adjacent soil and may also require pumping. Sheeting may consist either of vertical boards driven down with a maul as the excavation progresses, or of horizontal boards placed from the top down as the excavation progresses and having the ends of the longitudinal boards supported by bearing on the ends of the transverse boards. In quicksand or very wet soil it may be necessary to sheet with light interlocking steel sheet piles, but in this case the problem will probably require special treatment and supervision of an expert.

If the wall is not in good condition, or if it is very heavily loaded or subject to impact or vibration or if it is necessary for any reason to remove large portions of the old foundation at once it may be necessary to support the whole wall temporarily during the underpinning process and it may also require bracing and strengthening.

If in very bad condition the wall may be strengthened by rebuilding certain portions of it or by reinforcing it with beams or clamps bolted very tightly to it and it may be braced by heavy inclined timbers having their upper ends seated in slots cut into the face of the wall and their lower ends engaging wedges or jackscrews reacting against temporary foundations on the surface of the ground outside the building.

The simplest form of temporary supports are needlebeams, which are simply horizontal beams passed through openings cut in the wall just above the footing and supported at the ends in such a way as to provide for lifting the wall to compensate for any settlement in the temporary support due to the removal of the old footings or the excavation for the new ones. Needlebeams should be long enough as to have abundant clearance between their end supports for the excavation for the new footings. The inner ends of the beams are generally supported on timber sills parallel to the walls which, for heavy buildings, are usually set on a grillage of timbers transverse to the wall, distributing the load over a sufficiently large area of the cellar floor or the ground underneath the floor if the latter is removed. This method occupies a considerable space in the cellar or basement of the building and must be modified if the space is inadequate, obstructed or inaccessible. The outer ends of the needlebeams are usually supported on jackscrews and wedges on vertical shores or cribbing built up from the surface of the ground. Wedges or shims are driven between the wall and the tops of the needlebeams to give solid bearing for the latter and the wedges or jackscrews under the outer ends of the needlebeams are simultaneously set up sufficiently to start a horizontal crack between the brick walls and the footings, thus demonstrating that the entire load has been transferred to the needlebeams before the removal of the old foundations is commenced.

ARRANGEMENT OF NEEDLEBEAMS

For comparatively light structures 12 x 12-inch timbers spaced up to 10 or 12 feet apart horizontally are frequently used for needlebeams, because they are of standard sizes, easily secured and easily disposed of in the open market. For heavier loads the spacing between the timbers is reduced and sometimes the timbers are used in pairs, in which case one is put directly over the other or sometimes even sets of four are used. When one timber is placed directly over another it may take bearing on the whole length of the lower timber and not be attached to it, in which case the two timbers will simply have double the strength of a single timber. Frequently, however, the strength is increased by supporting the upper timbers on fillers inserted between it and the lower timber at points intermediate between the wall and the supports of the lower timber, thus increasing the strength of the upper timber by reducing its span, and increasing the strength of the lower timber by shifting the load to points nearer the supports. If the two 12 x 12-inch timbers are in contact throughout their entire length and are thoroughly keyed and bolted together, their strength may be approximately four times as great as that of a single 12 x 12-inch timber.

Sometimes the exterior ends of the needlebeams are carried on sills parallel to the wall and the sills are supported on heavy cribs or grillages that distribute the load over the surface of the ground. Frequently two or more lines of sills are used and the upper line on which the needlebeams are bearing supported on jackscrews seated on a lower line or pair of sills. This allows a larger number of jackscrews to be easily arranged and operated, making the support of the building more uniform and provides conveniently for blocking and wedging between the jackscrews to permit the release of the latter, and to prevent any danger from possible breakage of screws.

The sills may be 12 x 12-inch timbers or have any other convenient cross-section or steel I-beams may be used for either the needlebeams or sills, or both. I-beams are usually taken from convenient stock most easily available, and may have height of from 10 to 20 inches and length of from 10 to 40 feet.

JACKSCREWS

Underpinning jackscrews are of very simple construction, consisting of a short screw having a capstan head with a spherical or conical bearing on a concave loose washer or bearing plate, and engaging a heavy wide nut bearing on the upper surface of a sill or on the end of a bored vertical timber from 2 to 10 feet long called a pump log. Jackscrews have capacities from 1 to 10 tons or even more, lighter ones can be made of cast or wrought iron and the heavier ones of steel, all of them having large square threads and a low pitch. They should be well lubricated with heavy grease, carefully inspected on every job to see that none of them are cracked or broken. The jackscrews, especially when used singly or in pairs, should be always promptly followed up by blocking and wedging to prevent dropping the load if the screw fails. The jackscrews should be operated simul-

taneously and uniformly with a man at every screw or with several men, each taking a certain group of screws, and starting together at a signal, operating the first screw in each group at half or quarter turn with a lever of standard length, then moving to the next screw and operating it the same at signal, and so on, until all the screws have been turned the same amount, after which the operation is repeated until the required results are obtained.

The wall should be inspected at regular intervals, daily or oftener, and the screws operated if necessary to take up any settlement that may have occurred due to the disturbance of the ground in the excavating operations. After the weight of the wall is fully transferred to the needlebeams the wall foundations may be entirely removed and the men working safely under the needlebeams can excavate and sheet a full length trench of the required dimension down to the necessary depth with a bearing safe from disturbance, or on better soil or on solid rock or hardpan, as the case may be. After the bottom has been inspected and then prepared the new footing is built in it and the foundation constructed up to a convenient height.

Jackscrews should then be inserted on the new footing in the intervals between the needlebeams, with suitable bearings against the under surface of the wall and should be operated until they take the load from the needlebeams, transferring it to the new foundation and footings and maintaining it there until the compression and settlement, which is usually appreciable even for solid strata and sometimes considerable for soft material, ceases, after which the new jackscrews may be slacked off, the load restored to the needlebeams, the intermediate jackscrews removed and the foundation built up to and connected with the wall at points between the beams and the weight of the building transferred to the new foundation by wedging as previously described or sometimes by simply shimming and grouting and releasing the jackscrews under the needlebeams, which are eventually removed and the foundation completed in the positions that they had occupied.

CANTILEVER NEEDLEBEAMS

If the cellar of the building or the space adjacent to the wall on the exterior is inaccessible for underpinning operations it is possible to carry on the latter from one side of the wall only, by means of cantilever needlebeams fulcrumed far enough away from the wall to permit space for excavation under the wall, and anchored at the long end of the cantilever arm by heavy loads of ballast or by reaction against the weight of the building and its contents. Similar cantilevers can be arranged to support the building from the exterior without entering the cellar or cantilevers from the outside may be fulcrumed from heavy rakers or inclined posts placed against the base of the building. It is also possible to carry on the excavating almost within the limit of the thickness of a heavy wall, if necessary, by the use of special methods that require expensive equipment and expert supervision and labor.

Where it is not allowable to interfere at all with the existing foundations, the [illegible] extended by making sectional tunnels under them and building wider and deeper [illegible] the tunnel or additional footings may be built in the trenches alongside the old footings and b[illegible] to the latter, or foundation piles, piers or walls may be driven on one or both sides of the old footings and support the latter directly or by means of transverse beams or girders seated on them and passing under the old footings. These methods are, however, elaborate and costly, and should be resorted to only under expert direction.

UNDERPINNING BY PROTECTION

Foundations having their footings on gravel, clay, earth, sand or even quicksand may be entirely adequate and satisfactory for existing conditions but may be threatened by contemplated excavations or other operations that may be adjacent to them that will disturb the soil or soil pressure and threaten the possibility of a settlement or displacement of the soil that would undermine the footing and cause settlement and displacement to the foundation.

In such case the foundations may be safeguarded by operations equivalent to underpinning that will confine the material already under the footings and prevent the possibility of its flowing away. This can sometimes be accomplished by simply driving a line of sheet pile close to a footing to a greater depth than the proposed new excavation or beyond the limit of soil displacements. Equivalent results may be obtained by building a concrete retaining wall in the same position to serve the same purposes as the sheet piling. This wall can be built before the other operations are commenced, by digging alternate pits and in them constructing sections of the remaining wall subsequently joined together by intermediate sections built in excavations made between the first sections and thus providing a continuous structure without exposing any large surface of the ground and without requiring difficult trenching and bracing. An advantage of such a retaining wall is that it may often form a necessary part of the permanent structure so that its construction may involve little or no expense in addition to that necessary for the other work.

Philadelphia's Big Paving Program

Philadelphia, according to Chief Fred. C. Dunlap, of the Bureau of Highways, is expecting to pave 60 miles of streets this year, $1,000,000 of the cost to be paid out of current revenues and $5,000,000 obtained from a loan. The paving program contemplates spending about $20,000,000 altogether paving 50 miles each year for the next four years. The plan in general is to use this money not for repaving present overcrowded thoroughfares, but to attract traffic to new thoroughfares by giving them good modern pavements and thus draw away traffic from those which are already overcrowded. These streets include Delaware avenue, Fifth street, Germantown avenue, Ridge avenue, Spring Garden street, Gerard avenue and others.

NEWS OF THE SOCIETIES

May 16-18—AMBASSADORS & MINISTERS OF WORLD TRADE. Conference under auspices of NATIONAL ASSOCIATION OF MANUFACTURERS. New York City.

May 17 — CLEVELAND SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Annual dinner.

May 17-19—NATIONAL FIREMEN'S ASSOCIATION. Twenty-third annual convention. Fort Wayne, Ind.

May 18—KENTUCKY LEAGUE OF LOCAL BUILDING ASSOCIATIONS. Newport, Ky.

May 18—BIRMINGHAM SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Annual business meeting. Southern Club.

May 19—EASTERN NEW YORK SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Edison Club Hall, Schenectady.

May 19 — SAN FRANCISCO SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

May 20 — AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, 370th meeting, Engineering Societies Building, New York City.

May 20 — PHILADELPHIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Annual dinner, Hotel Adelphia Roof.

May 21 — ATLANTA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with ATLANTA SECTION, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

May 21 — CENTRAL PENNSYLVANIA SECTION. Spring meeting. State College with headquarters at University Club.

May 23-26—NEW JERSEY STATE BUILDING TRADES COUNCIL. Atlantic City, N. J.

May 25-6—NATIONAL INDUSTRIAL TRAFFIC LEAGUE. Cleveland, O

May 23-26 — AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Spring meeting. Congress Hotel, Chicago.

May 31-June 5—NATIONAL ELECTRIC LIGHT ASSOCIATION. Pasadena, Cal.

June 14-16—NATIONAL FIRE PROTECTION ASSOCIATION. Annual meeting. San Francisco.

June 15-17—LEAGUE OF MICHIGAN MUNICIPALITIES. Annual Convention. Kalamazoo, Mich.

June 20-24—AMERICAN SOCIETY FOR TESTING MATERIALS. Annual meeting. Asbury Park, N. J.

Sept. 28 (10 days)—NEW YORK ELECTRICAL EXPOSITION. Seventy-first Regiment Armory, New York City.

Oct. 11-14—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual Convention, Atlanta, Ga. Hotel Ansley. Secretary, James J. Mulcahey, Municipal Building, Denver, Colo.

Oct. 24-8—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Southern Hotel, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Nov. 14-18—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

NATIONAL TRAFFIC HIGHWAY ASSOCIATION

The annual meeting of the National Highway Traffic Association was held at the Automobile Club of America, 247 West 54th street, New York City, at 8 p. m., on Friday, May 13, 1921.

An informal dinner, at $1.50 per cover, was served in the Grill Room of the club at 7 p. m. The public was cordially invited to attend the dinner and take part in the discussion of the several topics to be presented.

Papers were presented on "Relation of Methods of Financing Highway Improvements to Present and Future Traffic," J. E. Pennybacker. "Highway Improvements Should Be Based on Transportation Surveys," Arthur H. Blanchard.

Reports were presented by the committee on sign posting for detours and through routes in municipalities; on regulation of overloading of motor trucks; on regulations covering speeds, weights and dimensions of motor trucks and trailers.

AMERICAN WATER WORK ASSOCIATION

Forty-first annual convention, Cleveland, Ohio, June 6-10, 1921. Executive committee meeting at 2 p. m. Other committee meetings. Group meetings—Arrangements will be made to have members in attendance Monday meet in small groups interested in topics that will be announced later. Evening—Address of welcome and informal reception with dancing.

June 7—President's address. Progress in Filtration, by J. W. Ellms. Construction Progress of the Cleveland Water Works, by A. V. Ruggles. Operation of the Mechanical Department of the Cleveland Water Works, by L. A. Quayle.

Afternoon—Effect of Cleaning Mains at Kansas City on Their Capacity, by C. S. Forman. The Waste of Water in Detroit, by G. H. Fenkell. Water Rates, by N. S. Hill, Jr., and J. N. Chester. Election, by districts, of members of the nominating committee. Ladies' auto trip to the Cleveland Yacht Club.

Evening—Water Supply from the Supply Man's View Point, by Charles Ade. Electrical Control of Valves, by Peter Payne Deane. Experience in the Development of Oil Engines, by F. B. Leopold; Standardization of Meters, by K. K. Blanchard.

June 8—The Romance of Water Storage, by Col. George A. Johnson. The Water Works of Erie, Pa., by John N. Chester. Reports of standing committes and special committees. General business. Selection of place for holding the 1922 convention.

Afternoon—Licensing Operators of Water Purification Plants in New Jersey, by Charles H. Capen, Jr. Improving the Scientific Features of Water Works Operation in Texas, by L. O. Bernhagen. The Small Plant Operator as a Scientist, by Abel Wolman. The Loading of Filter Plants, by H. W. Streeter. Tastes and Odors with Chlorination, by W. A. Sperry. Quality of Water at Different Points on a Water System, by S. T. Powell. State vs. Local View Point on Filter Plant Control, by Robert B. Morse.

Evening—Theater party for the ladies. Smoker for the men. Rainbow Room, Hotel Winton.

June 9—The Chemical and Bacteriological Section will hold separate meetings Thursday, program for which will be announced later. Report of committee on standardization of water meter specifications. Caleb M. Saville, chairman. Use of Dynamite in Breaking Out Old Water Mains, by Alvin Bugbee. Tapping Large Steel Mains Under Pressure, by D. F. O'Brien.

Afternoon—Mechanical Aids in Distribution Work, by W. M. Mitchell. Ownership and Operation of Trench Excavators and Other Mechanical Equipment by the Water Department of Baltimore, by V. Bernard Siems. Other practical operation papers. Discussion of superintendents' topics. Questions and answers. An afternoon card party for the ladies.

Evening—Moonlight boat ride, with dancing.

June 10—Superintendents' topics and questions continued. Superintendents' Day program will be continued in the afternoon if there is sufficient material and interest. Arrangements may be made for talks, illustrated by lantern slides and moving pictures for the evening.

ASSOCIATED PENNSYLVANIA HIGHWAY CONTRACTORS

At the first meeting of the Associated Pennsylvania Highway Contractors at Harrisburg, February 18, there were about 50 members in attendance and an announcement was made of the election by the board of governors of Chas. F. Puff, Jr., Assistant Chief Engineer of the Bureau of Highways, Philadelphia, as secretary and general manager with offices at 200 North 3d street, Harrisburg.

The association, which is a member of the Associated General Contractors of America, publishes a monthly bulletin in which there is now appearing a series of consecutive articles published under the headings following: General Factors, Excavation and Gravel, Concrete Pavement, Concrete Base Course, Sub-base Courses, Stone Backfill, High Culverts, Under-drain, Gutters, Curbing, Pavement, Bituminous and Other Pavements and Miscellaneous.

The officers of the association are S. M. Tarvin, W. D. Hill, E. P. Arbogast and Edward McCrady.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

The Materials Handling Division of the society has a membership of nearly 1,000 with an Aims and Organization Committee which reports, in part, that "material handling" divides itself into: (1) The consideration of the detailed design and operation of mechanical equipment for handling material, and, (2) the economical and efficient application of this equipment in the arts and industries.

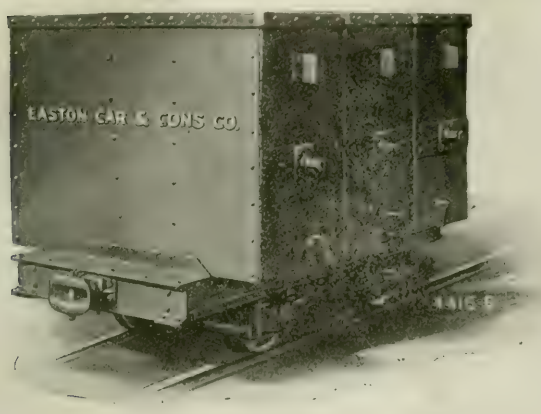
Material handling has to do with the multitudinous operations of "picking up and putting down" materials in process of production, and the handling problems of the linkages between common carriers and delivery to the user. The Professional Division, therefore, will approach the problem in general, as follows: Make a survey of the existing industry to ascertain the present state of the art.

Make studies for the improvement of machinery and equipment for the handling of materials.

Ascertain ways and means of reducing costs. An important branch of the work will be handling highway construction materials.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



THREE BOX FLAT CAR WITH STEEL BATCH BOXES

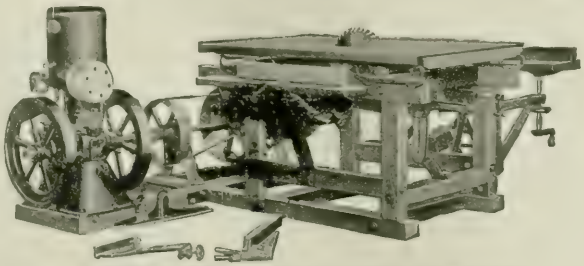
EASTON INDUSTRIAL RAILWAYS

The transportation of aggregate and cement between a central storage plant and the concrete mixing machine for highway construction is greatly facilitated by the use of Easton industrial railways equipped with two-box and three-box flat cars and bottom-dump and tip-over type batch boxes which are illustrated in Bulletin No. 510-A which shows the loading, unloading and transportation of materials with this equipment and gives several diagrams of different track arrangements for the service. Special prominence is given to the new three-batch box flat car, the use of which reduces the initial investment of car equipment by 20 per cent, train length by 15 per cent, dead weight of car by 10 per cent, and maintenance of cost by 36 per cent. The cost of labor is also reduced and the use of the resulting shorter trains makes operations quicker and more convenient.

The three-box car is equipped with standard foot brake, has a 3 x 8-foot frame, is 9 feet long over draw-head, weighs 1,250 pounds, and has a capacity of 6 tons. It will carry three batch boxes of 32 feet capacity or two of 64 feet capacity or, for gravel, macadam and cut-and-fill work, or wet concrete, can carry a rocker dump body of 40 feet capacity.

NOVO BEACH SAW RIG

The saw rig manufactured by the Novo Engine Co. is made in two sizes with 4 to 6 h. p. Novo reliable power engines with net weights of 1,550 pounds and 1,800 pounds without accessories and engines. The standard equipment includes a rip saw, cut-off saw, main drive belt, ripping and bevel gauge and a mitre gauge. It is furnished when ordered with jointer, boring attachment and an extension table.



ENGINE DRIVEN SAW RIG FOR CONSTRUCTION WORK

The bevel gauge permits making any cut that can be made on a tilting table, the mitre gauge can be set at any angle up to 45 degrees, and the frictionless roller table is an exclusive feature that enables heavy pieces to be handled as easily as light ones.

MARTIN PERFECT ROAD MAKER

The perfect road maker machine, manufactured by the Owensboro Ditcher & Grader Co., Owensboro, Ky., is a scraper hauled by teams or tractors, that is designed to surface the road with the blade working at one side and compensating hollows and projections so that the earth rolls out clean and follows a long projecting bar to the crown of the road, leaving the surface smooth and hard and in some cases completing the operation by one trip up and one trip down, thus acting as a time, labor and cost saver.

On all models the crucible plow steel cutting blade has both edges flanged and sharpened so that the machine can be used either for right or left-hand work. The heavy blade is 5 feet or 7 feet long in the different models and the landside is 9½ feet long. A steel plated wooden extension of the blade is 8 feet long, adjustable for different widths of roads and is attached to the rear end of the blade to move loose earth to the center of the road. The machine is provided with a special swivel joint, enabling it to be reversed in a minute, without the use of bolts or screws, while the horses or tractors are being turned. Besides road surfacing, the machine is efficient for cutting V-shape ditches and for backfilling pipe trenches.

CUTTING A ROAD ON NATURAL SURFACE

ROAD TOOLS

Catalog No. 81 of the Baker Manufacturing Co. contains 18 pages of illustrations and descriptions of road tools and earth moving specialties. The 1-yard self-loading scrapers have been in successful use since 1912 and can be operated by tractors for digging, hauling, dumping and spreading dirt. They are used on road and street excavation, canal construction, reservoir building, quarry stripping, street widening, subdivision work and railroad grading. In average soil with tractor hauling they take up a full load in a distance of 10 to 20 feet and in a few seconds of time and plowing is unnecessary. They can be hauled by 15 to 20 h. p. tractors, according to the character of the soil and a 25 h. p. tractor can haul three 1-yard scrapers. A powerful tractor can haul as many as six scrapers, operated by two men, and, with the special ditcher supplied can finish a 25-foot road.

A ¾-yard scraper is built and can be hauled by a 12 h. p. tractor and is recommended for road and street work and short haul and team excavating.

The "Uncle Jim" self-operating road leveler No. 1 has a cutting width of 30 feet with two blades 25 feet long set to cut off all elevations and roll the dirt back to the low spots. The blades are curved to impart a rolling motion to the earth and can be instantly retracted to pass through a 10-foot clearance without stopping the machine.

The "Jim Dandy" No. 2 has 18-foot blades made with 6-foot sections that are sharp top and bottom, reversible and interchangeable. They will pass through 8-foot openings, and can be handled with a 15 h. p. tractor.

Leveler No. 3 is drawn by a 10 h. p. motor and is designed mainly for patrol work, for quick and frequent maintenance on dirt roads. The speed is 14 feet when opened to full width. Four miles of road have been worked in an hour with ordinary tractors going over the road once.

Grader No. 5 is for use with light tractors. It has a reversing blade that can be set at any angle and locked in any position. It can cut to a depth of 8 inches below the bottom of the wheels. The No. 5 horse-drawn grader is similar to the tractor-drawn grader, has a blade 6 feet long and can be operated by either two or four horses. The 20th Century grader No. 1 hauled by two or four horses can be operated by the driver or by an extra man and weighs only 750 pounds. Buck or Fresno scrapers, drags and snow plows, the latter designed to be pushed by motor trucks or tractors, are illustrated.

INDUSTRIAL NOTES

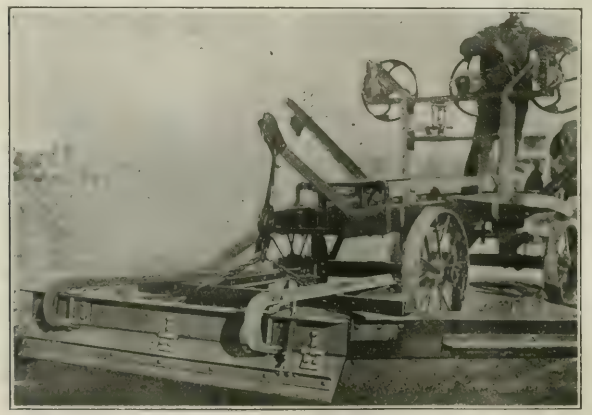
J. C. Tracy, for the past few years general sales manager of the Sterling Motor Truck Co., of Milwaukee, Wis., is now connected with the Hicks-Parrett Tractor Co., of Chicago Heights, in the capacity of vice-president and director of sales.

The Dominion Steel Products Co., Ltd., of Brantford, Ont., has made arrangements whereby it will manufacture gate valves and fire hydrants according to the designs of the Darling Valve & Manufacturing Co., of Williamsport, Pa.

BARBER-GREEN LOADERS ON PAVEMENT WORK

Barber-Green loading machines with self-feeding buckets have been used by the R. F. Conway Company and the Commonwealth Improvement Company, Chicago, and the Schmidt Construction Company, Chicago, and the Badger Construction Company, Milwaukee, for handling materials for concrete road construction. The jobs have been executed at the rate of 450 linear feet, with one mixer, 735 linear feet with two mixers, with total crews of 17 to 27 men. The total cost of handling broken stone and sand by the machine as compared with hand labor showed a saving of from $23.60 to $53.20 per day.

The Barber-Green machine has been successfully used for loading earth previously scraped into windrows for loading scarified macadam scraped into windrows, for digging surfacing materials from the right-of-way on highway construction, and for digging and loading gravel in a pit. Important features of the machine are the patented rotary disc feeder, the crawler type traction, and the adjustible measuring hopper with a capacity of 24 cubic feet that can discharge to either side of or in front of the machine.



BAKER ROAD LEVELER WITH AUTOMATIC DRAG ATTACHMENT FOR PRODUCING A FLAT SURFACE 5 FEET WIDE

PERSONALS

Randall, Ernest E., superintendent of the water department of Stoughton, Mass., has recently resigned that position.

Cook, Holton, is now resident engineer with the Kentucky Highway Commission on the constructing of a federal aid road, and will be located at Dixon, Ky.

Doolittle, Fred C., has been appointed highway maintenance engineer for Whitman county, Wash.

Morell, Samuel, Jr., has been made chief structural engineer of the Sanitary District of Chicago, and Julius R. Hall principal assistant engineer.

Francisco, J. O., formerly field engineer of the Colorado State Highway Commission, is now road engineer of La Platte county, in charge of maintenance and construction.

Murray, Leonard, is now in the employ of the engineering department of Watertown, N. Y.

Baum, H. J., formerly assistant engineer at Johnstown, Pa., has been appointed city engineer of Altoona, Pa.

Mead, Thomas, has been appointed county engineer of Whitman county Wash.

Chaffins, Major Clyde J., has been made office engineer of the Idaho Bureau of Highways in the Coeur d'Alene office under W. J. Bassett, district engineer.

Spring, C. H., is now office engineer of the division office of the North Carolina State Highway Commission at Greensboro, N. C.

Nason, David J., has been elected city engineer of Bangor, Me.

McKee, J. B., has been elected city engineer of Plattsmouth, Neb.

Anderson, Nels J., has been elected city engineer of Stromsburg, Neb.

Peterson, Carl H., formerly city engineer of Cadillac, Mich., has been appointed city manager of Mt. Pleasant, Mich.

Mahaffy, J. L., has been appointed town engineer of Montreal West, Que.

Peck, Frank S., formerly state highway engineer of South Dakota, has been appointed highway engineer of Minnehaha county, S. D.

Brownell, James P., has been appointed city engineer of Carthage.

Teed, A. J., has been appointed to the position of city engineer of Cadillac, Mich.

Hastings, Elwin S., and White, Alfred E., have been appointed acting division engineers of the New Hampshire State Highway Department.

Burton, Frank, has been appointed commissioner of the department of buildings and safety engineer of Detroit, Mich.

Tong, B. H., formerly assistant city engineer of Bismark, N. D., has been appointed superintendent of highways of Emmons county, N. D.

Moore, Warren E., has been elected commissioner of public works of Oklahoma City.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Municipal Journal and Engineer, Inc.
Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879.

Vol. 50 MAY 21, 1921 No. 21

Sewage Disposal at Worcester, Mass.

This is one of the oldest and most scientifically operated plants in the country, and the experiments on septic and Imhoff tanks, contact filters, trickling filters and activated sludge, that have been made here are of unusual interest and value.

The sewage treatment plant at Worcester, Mass., is one of the oldest in the country, and one of the two largest to use chemical precipitation, which method of treatment has been continued after it had been abandoned by all other cities, we believe. Providence abandoned the chemical precipitation of sewage during the war because of the impossibility of obtaining lime, permission being obtained from the federal government to substitute chlorine treatment temporarily. Following that, the freight congestion and other difficulties prevented returning to lime precipitation, but in February of this year the city decided to resume the lime treatment in a short time and preparations have continued and a contract has been let for the lime, and the renewal of chemical treatment may have taken place before this article is published.

During the past twenty years the officials in charge of the plant have conducted experiments on the various methods of treating sewage which have received general attention from time to time, such as the septic tank, Imhoff tank, activated sludge, etc. A brief review of the history of this plant and a somewhat detailed account of the experimental activated sludge plant were given in a paper before the Boston Society of Civil Engineers by Roy S. Lanphear, supervising chemist of the Worcester Sewage Department. From this paper the following has been abstracted:

Worcester's chemical precipitation plant was placed in operation March 25, 1890. In 1900 experiments on treatment were begun, settled sewage, chemical precipitation effluent, and septic tank effluent being run onto sand filters in that year. It was found that finely divided suspended matter in the septic effluent penetrated the surface of the filters and necessitated the frequent removal of large quantities of dirty sand, and filtering this effluent was abandoned in 1902. Settled sewage from chemical precipitation basins gave similar results. Effluents from chemical precipitation carried finely divided solids onto the sand filters and in addition the precipitation of lime there resulted in the formation of a hard crust on the filter, so that the rate of filtration of this effluent decreased more than 50 per cent in five years and it was necessary to remove as much as 4 inches of the material in a single cleaning in order to renew the original rate of filtration.

Late in 1904 arrangements were completed for delivering crude sewage directly to the sand filters and this method was continued until September, 1908, when change was made to the present method of passing the sewage through one or two settling basins giving a detention period of about 20 minutes; this settling being introduced to relieve the overloading of the sand filters with scum close to the distributors. It is found that "the disposal of suspended solids as sludge by pumping is much cheaper than the removal from the filters, and the short detention period of the sewage removes only the heavier and coarser suspended solids."

In 1905 septic tank effluent and settled sewage were treated in experimental contact filters, there being two primary beds and one secondary bed, each about 1,200 square feet in area and filled with 40 inches of crushed stone of ¾-inch to 2½-inch size. Results from these were unsatisfactory, a rate of 500,000 gallons per acre daily giving a putrescible effluent much of the time and the beds losing 12 per cent of their capacity in a single year. In 1906, the stone was removed from the primary beds, their depth was increased and they were used as septic tanks for one year, after which one of them was used as a settling tank for septic tank effluent, which was treated on trickling filters 5 and 7½ feet deep. In 1909 the preliminary treatment was changed to plain sedimentation, and in 1911 chemical precipitation effluent was applied to the shallower filter.

From the various experiments the following conclusions were derived:

"(1) The deeper filters gave the better effluent.

"(2) Purification was better with septic tank effluent than with settled sewage because ferrous iron of the sewage was removed to some extent in the septic tank by precipitation as sulphide of iron.

"(3) The odors accompanying filtration of septic tanks effluent were very objectionable.

"(4) Chemical precipitation effluent was filtered at a rate of 1,000,000 gallons per acre daily, and settled sewage at 700,000 gallons per acre daily with equally good results.

"(5) The cost of chemical precipitation eliminated the consideration of this process as preliminary treatment."

In 1911 an Imhoff tank and two trickling filters were placed in operation, each filter being 10 feet deep and one containing ¾-inch to 2½-inch crushed stone and the other ½-inch and 1½-inch stone. This plant was operated successfully for two years, the rate of filtration during the second year being 2,000,000 gallons per acre daily. The filter containing the coarser stone did not yield quite so good an effluent as the other, but caused much less trouble from surface pooling. Its effluent was non-putrescrible during warm weather and during the winter about 75 per cent of the samples treated were non-putrescible.

It was appreciated by those in charge that chemical precipitation of sewage was inefficient and costly, and in 1916 the superintendent of sewers recommended changing to a plant consisting of Imhoff tanks and trickling filters. At about the same time the State Department of Health began urging a new plant of this type.

Meantime, early in 1917, an experimental plant using the activated sludge process was constructed and placed in operation, in keeping with the general policy of the sewer department to test every promising method of sewage treatment. After 13 months of operation the supervising chemist was called to military service and consequently report upon the operation of the plant was not completed before November, 1919. This report indicated that the air requirements of treating Worcester sewage by the activated sludge process were large and the sludge disposal a serious problem. Six months before this report was available the state legislature passed an act requiring the city of Worcester to start work on a new sewage disposal plant before October of that year and to have the plant in operation by April 1, 1924. The superintendent of sewers again recommended the adoption of the Imhoff tank and trickling filter, the State Department of Health approved this and also the location proposed for the new plant, and the site of this plant is now being prepared and the outfall sewer extended to it.

ACTIVATED SLUDGE EXPERIMENTS

Mr. Lanphear devoted the larger part of his paper to a description of the experimental activated sludge plant and the results obtained in its operation, which we have considerably abbreviated in the following paragraphs:

The sewage treated in this experimental plant first passed through a bar screen with ½-inch openings and a grit chamber. Thence it entered a sewage aeration tank with a capacity of 25,283 gallons, with filtros plates in the bottom. The effluent from this passed to a sedimentation tank of the Dortmund type 14 feet in diameter and 9.6 feet deep. The sludge was lifted from this tank by air lift and discharged to either the sewage aeration tank, the sludge aeration tank, or to sludge tanks. A part of the sludge, with or without aeration, was returned to the sewage just before it entered the sewage aeration tank. The sludge re-aeration tank had a capacity of 4,386 gallons.

From 75,000 to 125,000 gallons of sewage was treated daily, using from 2 to 5 cubic feet of free air per gallon, the sewage being aerated from 3.8 to 6.2 hours and the sludge from 2.8 to 6.5 hours. Careful records were kept of all temperatures and it was found possible to operate the activated sludge process in this New England climate, where, for a period of 6 weeks, the average maximum temperature of the air was below 32 degrees, the minimum during one week varying from 16 degrees to 2 degrees below zero.

Foaming occurred in the sludge re-aeration tank during the first ten days of operation and it was necessary to raise the tank walls 6 inches and cover the tank with chicken wire to prevent the foam from going over the walls. Foaming also occurred at other times, usually with the aeration of activated sludge of poor quality.

Analyses of the air after use in the aeration tanks showed that oxygen was removed and carbon dioxide formed, about 2.1 and 4.3 per cent in the sewage and the sludge aeration tanks, respectively. A small amount of methane and heavy hydrocarbons also was formed.

There was a general lack of reduction of free ammonia by this process, considerable reduction of albuminoid ammonia and oxygen consumed, from 85 per cent to 95 per cent removal of suspended solids, about 90 per cent removal of iron, and an entire absence of nitrification. Clarification was generally excellent and in the absence of nitrification exerted considerable influence upon the stability of the effluent. The dissolved oxygen content of the effluent usually averaged from 20 per cent to 30 per cent of saturation, but many times was zero in the afternoon. In general effluents having less than 0.2 part of total albuminoid ammonia, about 0.05 part of suspended albuminoid ammonia and less than 3.0 parts of suspended solids were of good appearance but the stability was variable, being influenced by the actual content of organic matter and suspended solids. The effluent generally contained from 50,000 to 350,000 bacteria per c. c.

Worcester sewage contains so much trade wastes of such varying character and quantity that nitrification did not take place with the quantities of air and periods of aeration used, but a stable effluent was obtained by the reduction of the organic content. Owing to lack of nitrification and low dissolved oxygen content, there was no factor of safety or stability of the effluent such as is usually present in effluents from the biological processes and consequently sewage of greatly varying character was not uniformly well

treated. Greater quantities of air and longer periods of aeration would probably have produced better results in this respect.

Comparing this process with the Imhoff tank and trickling filter plant, the latter, treating stronger sewage and operating at a rate of 2,000,000 gallons per acre, gave an effluent which was generally slightly turbid and even slightly colored at times, and of greater organic content, but it contained about 0.5 part of nitrogen as nitrates and was perfectly stable during warm weather and 75 per cent of the time during the winter; while the activated sludge effluent was generally clear, colorless and of good chemical quality, but lacked stability.

After analyzing the results of the experiments, Mr. Lanphear stated that they indicated, but with considerable uncertainty, that "a total quantity of about 4 cubic feet of free air per gallon of sewage, 6 hours aeration of sewage and 6 hours re-aeration of sludge, using about 25 per cent returned sludge and treating average to strong sewage, should give a final effluent of good chemical quality and having a stability of from 75 per cent to 90 per cent."

Here, as at other plants, the sludge problem was considered an important one. The quantities were found to be much greater than those produced by any other process of treatment tried at Worcester, varying from 12,000 gallons per million gallons of sewage in summer to 25,000 gallons in winter. The sludge contained from 97.1 per cent of moisture in summer to 98.7 per cent in winter. The dried sludge contained from 50 per cent to 70 per cent of organic matter, from 8.5 per cent to 18 per cent of iron, from 2 per cent to 9 per cent of fats, and from 4 to 6.5 per cent of nitrogen. Worcester activated sludge was found as dense as that which has been obtained elsewhere, and it was believed that it would be difficult to obtain, without concentration, activated sludge having less than 97 per cent moisture.

Most of the sludge was dried upon sand beds, but this was decided to be impracticable because the beds could not be dosed to a greater depth than 4 or 5 inches. Concentration experiments were made in two tanks, one 6 feet deep and the other 18½ feet deep. Heavier sludge could be drawn from the bottom of the deeper tank if extremely long periods of concentration were used, but in no instance was sludge obtained containing less than 95 per cent moisture. Concentration of sludge for from 15 to 24 hours decreased the volume about 50 per cent and the water content from 98 per cent to 96 per cent.

Pressing the sludge was attempted in a section of a press of the Bushnell type which had been used in the plant for chemical precipitation sludge, but it was found to be unsuitable for pressing activated sludge unless about 2,500 pounds of lime in the form of milk of lime were added to 100,000 gallons of sludge and pressing continued for about two hours at 60 pounds per square inch. It was believed that to be successful, a press should de-water the sludge to about 70 per cent. moisture during the first 20 or 30 minutes of operation, and the addition of lime should not be necessary.

Comparisons were made between activated sludge and that from the Imhoff tank and final settling basins as fertilizers. The total nitrogen content of the activated sludge was about 60 per cent greater than either of the others, but the available nitrogen, while somewhat greater than the Imhoff tank sludge, was less than that in the settling basin sludge, and the same was true of total phosphoric acid. Based on the unit quantity of sewage treated, the nitrogen content of activated sludge was approximately 2½ times as great as combined Imhoff tank and final settling basin sludge. But if revenue is desired from the nitrogen content, facilities would have to be provided for handling six times as much unconcentrated or three times as much concentrated activated sludge as of the other two sludges combined.

Improved Heavy Traffic Pavements in Jersey City

By Clarence D. Pollock

Granite blocks laid on both old and new foundations, with hot asphalt mastic filler. Special attention paid to details.

Jersey City, N. J., has been greatly hampered for funds for street improvements due in a large measure to the fact that so much of its most valuable portions, including its water front, is owned by the railroads and consequently under state control and taxation. As a result the city was paved largely with both new and second-hand Belgian blocks which were obtained from near-by quarries of trap rock in New Jersey.

LAYING GRANITE PAVEMENT ON PACIFIC AVENUE

During the past few years great progress has been made in getting improved pavements, both in the selection of materials and in improved workmanship. The city has a commission form of government, Michael I. Fagan being the present Director of Streets and Public Improvements, while C. A. Van Keuren is the chief engineer.

Two important improvements carried out during the past year were the repaving of Newark avenue from Summit avenue to Westside avenue, excepting the portion in the tracks; and the repaving of Grand street from Mill Creek to Communipaw avenue, together with portions of Communipaw avenue and Pacific avenue, except the area in the railway tracks. These two contracts were for improved granite block pavement on concrete base with an asphalt mastic used as a joint filler.

The Newark avenue contract amounted to 7,500 square yards over old concrete foundation, and the other contract to 24,610 square yards, of which 3,710 square yards was over the old concrete base and 20,900 square yards was on a new concrete base 8 inches thick.

Jersey City contracts are let on the percentage method. The engineer makes a detailed estimate of quantities, giving unit prices, and the total of this estimate is taken as 100 per cent. The contractors submit their bids as percentages of the total of the engineer's estimate, the object being, of course, to eliminate unbalanced bidding. On Newark avenue the percentage bid was 99½ per cent, while on Grand street it was 120 per cent. The low bidder on Grand street was Graham Van Keuren, of Jersey City, and on Newark avenue William Van Keuren was the lowest bidder.

The blocks specified in each of these contracts were the standard granite blocks from 8 to 12 inches in length, 3½ to 4½ inches in width and 4¾ to 5¼ inches in depth, laid upon a sand cushion not to exceed one inch in depth; upon a portland cement base 8 inches thick where a new foundation was used.

The specifications called for blocks so dressed that the faces would be approximately rectangular in shape, and the ends and sides sufficiently smooth to permit the blocks to be laid with joints not exceeding one-half inch in width at the top and not exceeding one inch in width at any other part of the joint. The head of the block was to be so cut that there would be no depressions measuring more than three-eights of an inch from a straightedge laid in any direction on the top and parallel to the general surface thereof.

The blocks were paved in straight courses at right angles to the length of the street and the longitudinal joints were broken by a lap of at least three inches. Great care was given to the ramming of the pavement and it was specified that the ratio should be not less than two rammermen to five pavers employed on the work. It is very important that the pavement be thoroughly rammed as the success of the result depends so largely upon this part of the work.

Special attention was devoted to securing an even sand cushion of one inch under the blocks. In earlier work defects had developed and were probably due largely to great variation in depth of the cushion.

Formerly the improved granite block pavements had been laid with portland cement grout, but this work was not wholly satisfactory because of pea-stone in joints or uneven sand cushion and the like which cause the filler to break out in places. Hence on these contracts a change was made to bituminous joint filler which has proved very successful. The joint filler was a hot asphalt mastic, the specifications for which were as follows:

The joint filler used shall be a mixture of paving cement

COMPLETE GRANITE PAVEMENT ON GRAND STREET

described hereafter, and hot dry sand, in the proportion not to exceed one part sand to one part paving cement by volume, or as much sand up to this proportion as the paving cement will carry. The sand shall all pass a 10-mesh sieve. It shall be clean and heated to a temperature of not less than 300 degrees Fahrenheit, nor more than 400 degrees Fahrenheit, and shall be within these limits when mixed with the paving cement. The paving cement shall be heated in kettles, properly equipped with an approved thermometer, to a temperature of not less than 325 degrees Fahrenheit, nor more than 400 degrees Fahrenheit, and shall be poured when between these limits.

The mixture shall be made in a concrete carrier pushcart of seven (7) cubic feet capacity, or other approved receptacle.

Approximately 2¼ cubic feet of the hot asphalt cement shall be poured into the cart, the hot sand then added in the proportion indicated above, and the mixture thoroughly stirred with a rake or perforated hoe. The mixture shall then, without delay, be flushed on the surface of the blocks and pushed into the joints by squeegees or other approved means, reflushing or repouring if necessary, until the joints remain permanently filled, flush with the surface of the pavement. The cart or container shall be entirely emptied before refilling.

The appliances for heating the materials for filling the joints shall be of such efficiency and numbers as will permit the pourers to follow closely the rammers, and all joints of rammed pavement shall be poured with the filler before the cessation of work for the day. In case rain stops the filler gang before its work is finished, the joints shall be protected by tarpaulins or other means, so as to keep out the water. Under no circumstances shall the filler be poured into wet joints.

The paving cement shall be asphalt paving cement, as hereinafter specified.

The asphalt paving cement shall be obtained by the distillation of the asphaltic petroleum at a temperature not exceeding 700 degrees Fahrenheit, and shall comply with the following requirements:

(a) It shall be homogeneous.

(b) Melting point shall not be less than 115 degrees Fahrenheit nor more than 130 degrees Fahrenheit. (Ball and ring method.)

(c) Solubility in carbon tetrachloride shall not be less than 98½ per cent.

(d) Penetration at 77 degrees Fahrenheit shall not be less than 60 nor more than 100, the penetration test being made with a No. 2 needle for five seconds under a load of 100 grams; and the penetration at 100 degrees Fahrenheit shall not exceed three and one quarter (3¼) times its penetration at 77 degrees Fahrenheit, the condition of time and load being as above established. The contractor, before beginning work, shall obtain from the engineer a statement in writing as to the penetration desired for any particular contract, and a variation of not more than 10 points either way from this penetration will be permitted.

(e) Ductility at 77 degrees Fahrenheit shall not be less than 40 centimeters at the penetration called for.

(f) It shall not lose more than 3 per cent by volatization when maintained at a temperature of 325 degrees Fahrenheit for five hours, nor shall the penetration of the residue after such heating be less than one-half the original penetration.

No traffic of any description shall be permitted on the pavement until the joints have been completely filled with the bituminous filler as described and it has hardened.

The contract prices for granite block pavements shall cover the cost of materials and labor necessary to furnish and lay the pavement as specified, cost of furnishing such samples for testing as may be required, the cost of providing thermometers as specified, and the cost of maintaining the pavement in good condition as required by the contract.

Due to the care in drawing the specifications and the laying of the pavements, good results have been obtained. The surface of these pavements is smooth and even and the joints are thoroughly filled with the asphalt mastic. The result is very creditable to Director Fagan and Chief Engineer Van Keuren.

Effects of Organic Impurities on Concrete

Minute quantities of tannic acid reduce strength one half. Surface loam always reduces strength. Other conclusions from an investigation.

It has long been recognized that impurities of an organic nature reduce the strength of concrete, even in some cases entirely destroying the hydraulic properties of the cement. This is probably the reason for the weakness of concrete caused by the addition of loam in small quantities, although small percentages of clay thoroughly admixed do not seem to be injurious.

A general investigation of the effect of organic impurities has been conducted by Prof. Duff A. Abrams of Lewis Institute, and the results have been published recently by the Structural Materials Research Laboratory as a reprint from the Proceedings of the American Society for Testing Materials for 1920.

It was impossible to secure natural sands containing different known percentages of organic materials for a study of the quantitative effect of such impurities, and the laboratory therefore investigated the effects of tannic acid as a surface coating for sand particles, having decided that the effect upon the strength of concrete was practically the same as that of the organic impurities found in top soil. These investigations were begun in 1915 and continued for four years or more. Tannic acid was applied as a surface coating in various quantities up to 0.4 per cent by weight. Compression tests were made on 3-inch by 6-inch concrete cylinders. Mixes were used varying from 1:5 to 1:2. The size of aggregate ranged from a fine sand to a ¾-inch graded aggregate. Tests were made on all mixtures and sizes of aggregates at ages of 7 days, 28 days, 3 months, 1 year and 2 years, specimens being stored in damp sand. About 2,000 tests were made in this investigation. The principal conclusions from the investigation were as follows:

1. It is believed that the results of these tests are, in general, typical of the effect produced by organic impurities in concrete, judging from tests with natural sands containing organic matter, made in Lewis Institute and other laboratories.

2. The strength of concrete was reduced for all percentages of tannic acid, for all mixes and ages covered by these tests. Less than 0.1 per cent of tannic acid in terms of the weight of the aggregate may reduce the strength of the concrete to one-half its normal value.

3. Lean mixtures are more affected by tannic acid than the rich ones.

4. The mixtures from the finer aggregates are less affected by tannic acid than those from the coarser aggregates.

5. All of the effects mentioned above may be summed up by saying that the reduction in strength of concrete is a function of the concentration of

tannic acid in the mixing water. An equation is given which represents this relation for the 28-day tests.

6. The results of these tests indicate that the wetter consistencies would be less affected by the presence of organic impurities than the drier ones.

7. The strength falls off rapidly for small percentages of tannic acid and less rapidly as higher percentages are reached.

8. The 7 and 28-day strengths are reduced to a greater extent by tannic acid than at ages of 1 and 2 years.

9. Some of the 1:5 mixes in which the higher percentages of tannic acid and the finer sands were used (2 to 3 per cent solution) disintegrated before the time of test. The 1:7 mixes (3 to 5 per cent solution) were destroyed in removing the molds.

10. The tests confirm the results of many other investigations made in this laboratory in showing the fundamental dependency of strength of concrete on the quantity of mixing water as expressed by the water ratio.

11. The strength of concrete (stored in a damp place) both with and without tannic acid increased with age. The strength for a given condition was a logarithmic function of the age.

The paper herein referred to gives the complete figures of the tests on which these conclusions are based and also diagrams prepared from such figures.

Attention is called to the colorimetric test using sodium hydroxide as a convenient method of testing for organic impurities in natural sands. This test consists of shaking the sand thoroughly in a dilute solution of sodium hydroxide (NaOH) and observing the resultant color after the mixture has been allowed to stand for a few hours. For this purpose fill a 12-ounce prescription bottle to the 4½ ounce mark with the sand to be tested. Add a 3 per cent solution of sodium hydroxide until the volume of sand and solution, after shaking, amounts to 7 ounces. Shake thoroughly and let stand for 24 hours. If the solution at the end of that period is colorless or has a light yellowish color, the sand may be considered satisfactory in so far as organic impurities are concerned. On the other hand, if a dark colored solution is produced, the sand should not be used in high-grade concrete, or use l only after mortar strength tests have shown it to be satisfactory for the purpose.

The report states that surface loam always decreases the strength of a properly proportioned concrete, both because of the presence of organic materials and also because additional water is required to produce a concrete of a given plasticity. There are cases in which a coarse sand will give a stronger concrete if loam or other finely divided material be added, but in such cases the addition of fine sand would be much better, the increase in strength due to the better grading of aggregate secured by the addition of loam being more than sufficient to counterbalance the ill effects of the organic material.

It seems to be definitely indicated by these results that care should be taken to eliminate surface loam from sands to be used in mortar or concrete.

Care should always be taken to remove the overburden of soil in sand and gravel pits. Washing conducted on a comprehensive scale is generally effective in removing loam when mixed with sand or gravel.

PREPARING TO DYNAMITE PAVEMENT CONCRETED IN COLD WEATHER

Results of Concreting a Highway in Cold Weather

A portion of Federal Aid Project 22 in Pennsylvania was concreted during freezing weather and the pavement was so much injured by the frost that it was condemned.

The slabs were broken up by charges of dynamite that raised up the surface and broke it into fragments that could be reduced with picks and sledges and removed to permit the new concrete to be laid in its place.

Constructing a Brick Highway in Illinois

The brick pavement for Federal Aid Project 9 in Illinois is made with a sand-cement cushion on concrete foundation as shown in the illustration.

STRIKE-OFF FOR SAND-CEMENT CUSHION OF BRICK PAVEMENT

After the cement and sand had been placed on the foundation they were leveled accurately by means of a special striker having two transverse wooden straightedges, set to the exact level and supported at each end by a truck with an extended wheel base, giving it firm bearing on the forms on each side of the roadway. The trucks were each made with a pair of long wooden rollers and the striker was provided at each end with an inclined handle about breast high by which it was conveniently manipulated. The brick laying was maintained as close as convenient to the concreting. A space was left on each side of the brick surface that was afterwards finished to make the shoulder.

Pumps for Small Water Plants

In a paper before the Indiana Sanitary and Water Supply Association entitled "Rebuilding of Water Works," Charles Brossman described some changes made in the pumping plants of several Indiana cities. He believed that the small water utility presented a more difficult problem in its pumping plant than the large installation.

The town of Delphi, finding it necessary to cut down the operating cost of its steam plant, considered a new high-duty steam pump, pumping by different types of electrical equipment, and continuing to use the present equipment but cutting done the pumping time by installing a large elevated tank. It had cost $4,827 a year to operate the old pumps.

Using a high-duty steam pump without any change in labor, the total yearly cost figured $3,695, which, adding interest and depreciation at 10 per cent, would total $4,585. If a large tower had been installed in order to cut down the hours of pumping, the labor item would have been cut in half, but the interest and depreciation on the tower would have brought the total up to $5,500. Using electric driven pumps, making the plant automatic and cutting out all labor, it was estimated that the yearly cost would be less than $2,000, or about $2,800 with interest and depreciation added. Electric pumps were adopted.

For reserve power in case there should be an interruption in the electric current, oil and gasoline engines were considered and it was found that the gasoline engine fulfilled the requirements to better advantage than oil, being cheaper and more quickly started, although more expense to operate. Mr. Brossman advised that in selecting reserve pumping plant it is better to pay a little more and get a slower speed engine.

In Van Buren, a town with 1,200 population, current is furnished for pumping purposes at 2½ cents. Two pumps were installed, each of 125 g. p. m. and geared to a 10 h. p. slip-ring motor. These pumps are both controlled by a special design of automatic control having two regulators for each outfit. The pumps discharge into the main and are connected with a pressure tank 5 feet in diameter by 20 feet long. The motors are arranged for two speeds. One of the regulators will start the pump and run at a slow speed, and should the pressure continue to drop the second regulator will bring the pump up to [illegible] the pressure dropping still further, the second pump will cut in, first at half and then at full speed, until the total capacity of the plant is in service; and as the pressure increases the pumps will cut out of service again in reverse manner. In case of fire, a double-throw switch is used and thrown directly across the line, cutting out the automatic control and permitting a pressure of 90 pounds to be reached, excess pressure being taken care of by a relief valve.

This system has about 9,000 feet of mains and 18 fire hydrants and the entire plant was installed for $9,500 and is operated by the town marshall, who is also street commissioner and receives $20 a month for this service. In this plant the total cost of current for one year was $182 or about 21.7 cents per consumer per month. The test on the pump, allowing 5 per cent for slip, showed 600 watts per 1,000 gallons pumped, or 1,675 gallons per k. w. h. when the pump was first installed.

Duplicate Supply Mains

Water works men generally recognize the importance of insuring continuous service by providing duplicate pumping machinery, especially where the service is by direct pumping, and also duplicate mains between the pumping plant or reservoir and the town so that the service may not be entirely interrupted, as it would be in case of a break in an only main.

In spite of the self-evident desirability of such precaution, there are still many cities where the water official or departments find it impossible to obtain funds for duplicating the supply main, and the reading of many reports of water works officials brings to light numerous requests of this kind repeated year after year.

One of these is the city of Augusta, Ga. Fate seems to be particularly kind to that city in that it not only has heretofore refrained from permitting a break in the supply main which is the only one leading to the city, but last year gave the officials a gentle reminder of the seriousness of their situation without causing it to be really serious—that time. Last December this 24-inch main developed a crack which, had it occurred two blocks further east, would have made it necessary to cut off the water supply of the entire city for a period of about ten hours while the main was being repaired. A fire burning unchecked for ten hours could destroy many times the cost of a duplicate main. The reservoir is nearly three miles from the city and the cost of a duplicate main is estimated by the superintendent, J. H. Ferguson, to be about $91,000; but, backed by the reminder of the dire possibility just referred to, he urges that if necessary other improvements be held up so that the money can be obtained for carrying out this necessary work. "In view of the large sums of money that have been expended on improvements of far less importance, it is astounding that various administrations have incurred the tremendous responsibility of allowing this condition to continue."

Types of Road Receiving Federal Aid

The chief of the United States Bureau of Public Roads, Thos. H. McDonald, has issued a statement in order to clear up some misconceptions which have arisen, in some cases naturally and in other cases through misleading or false statements made by those interested in certain types of pavement; also to urge that state laws or other legislation be not so drawn as to specify the types of highways to be built in the states in question.

On March 1 of this year there had been completed or were in process of construction 22,030 miles of road that had received Federal aid, of which about 70 per cent consisted of earth, sand-clay and gravel, about 22 per cent of brick, bituminous concrete and Portland cement concrete, about 7 per cent of water-bound and bituminous macadam and about 1 per cent miscellaneous. The total estimated cost of these is about $362,000,000.

In each case the state initiates the road projects but an engineer of the federal bureau inspects the roads, studies local conditions and consults with the state highway department, and no projects are approved that are not considered suited to the conditions to be met.

"Many times the question has been asked the Bureau: What type of road is best? The answer is always the same: There is no one best kind or type of road surface." There must be a careful analysis of both the engineering and economic conditions for each particular case to determine the kinds of materials that can be used successfully, and after these facts have been determined then the various types of construction that can be used economically should be brought into competition.

Attempts have been made to embody in state laws or the governing conditions of bond issues a requirement as to the type or kind of roads to be constructed. "To follow such a course would be most unfortunate. The cost must always be considered in determining the type of road surfaces which are selected, and the allowable cost must be determined by the traffic which is to be borne." To a chamber of commerce recently asking for information, the Bureau replied: "Types of highways should not be specified by law. This is a matter to be decided by the state highway department, in which should be lodged full authority both to construct and to maintain. Competition between different types of materials should be maintained and selection made to fit traffic requirements in each case. The Bureau does not recommend any one type to exclusion of others."

Concerning earth roads, Mr. McDonald says: "Properly built earth roads are the fundamental requirement in all highway improvement. Regardless of the material or type of surfacing which is to be placed, the preparation of the road bed requires the highest engineering skill and experience. The department considers that the use of adequate sums for the securing of proper location, thorough drainage, permanent bridges and culverts, and the elimination of railroad crossings is demanded if enduring improvements are to result. Federal aid is allotted to the improvement of earth roads, but only with the stipulation that a suitable surfacing will be placed as soon as funds become available. This allows the road bed to be prepared and become thoroughly consolidated before the surfacing is placed, which is highly desirable from a construction view-point. To follow such a course, however, is out of the question when a road is heavily traveled, and some form of surfacing must be provided. To care for traffic under these conditions, frequently a sand-clay or gravel surfacing is provided, which will serve for several years and yet allow the road to be maintained under reasonably heavy traffic."

Package Garbage Collection in Trenton, N. J.

Garbage for the city of Trenton is disposed of by incineration in a plant that was built about 16 years ago at a cost of $28,000 and has been extended by the addition of two more incinerating chambers costing about $4,500 each.

Previous to 1916 the garbage was collected with few requirements concerning its condition, and was received at the incinerator in bulk in a wet, unsanitary and offensive state. About 6 years ago G. B. La Barre, then director of public safety, improved the system of garbage collection which now requires all householders and others to deliver the garbage in packages placed on the curb every alternate morning, and collected by the twenty two-horse two-yard dump wagons which are able to handle it much more quickly and satisfactorily than the old wet garbage, and to carry twice as much in bulk as formerly. Ashes are collected separately by four automobile trucks and ten wagons.

Before the war it was possible to secure waterproof pager bags with a capacity of about one bushel, at a cost of 80 cents per hundred. These were generally used to contain the garbage delivered to the city collectors. With the great increase in the cost of paper the price of containers advanced so much that they have generally been dispensed with, and the garbage is now usually wrapped up in wrapping paper or newspapers to exclude wet or sloppy material or to dry it at least partially before wrapping so that the weight is less and the general character much neater and less offensive than is the case with the old bulk garbage.

With the present population of about 120,000 the average amount of garbage collected is about 40 tons per day, the incineration costs $108,000 a year, not including the collection of garbage and the collection and disposal of ashes. It requires abut 125 tons per year of soft coal to operate the incinerator which derives a considerable proportion of the fuel burned from the paper wrappings and from the dried garbage itself. The cost of the disposal is about 33 per cent less than the former cost of the disposing of the wet garbage.

PUBLIC WORKS

Published Weekly
by
Municipal Journal and Engineer, Inc.
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba....$3.00 per year
All other countries .....$4.00 per year

Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

CONTENTS

SEWAGE DISPOSAL AT WORCESTER, MASS. 421
IMPROVED HEAVY TRAFFIC PAVEMENTS IN JERSEY CITY—Illustrated. By Clarence D. Pollock 423
EFFECTS OF ORGANIC IMPURITIES ON CONCRETE 425
Result of Concreting a Highway in Cold Weather—Illustrated 426
Constructing a Brick Highway in Illinois—Illustrated.. 426
PUMPS FOR SMALL WATER PLANTS 427
Duplicate Supply Mains 427
TYPES OF ROADS RECEIVING FEDERAL AID 428
Package Garbage Collention in Trenton, N. J..... 428
EDITORIAL NOTES 429
Types of Federal Aid Roads—Engineers for Public Positions—Publicity for Public Works
New York Loses Passaic Valley Suit 430
The Eartherete Road 431
WORK DONE DURING 1920 AND CONTEMPLATED DURING 1921—Table 432
WHAT ARE THE BEST METHODS OF HANDLING GRAVEL FROM CAR TO CONCRETE MIXER? 435
THE CARE OF CONCRETE MIXERS 437
To Keep Oil Out of Sewers 437
RECENT LEGAL DECISIONS 438

Types of Federal Aid Roads

A statement recently given out by Chief McDonald, of the United States Bureau of Public Roads, and quoted in part elsewhere in this issue, should be given the widest publicity, especially by the daily press and other papers that reach lawmakers rather than engineers and highway officials. Unfortunately more or less success has been achieved by those prejudiced in favor of different types of pavement in winning over to their special type either those at the head of state highway departments or those who have prepared the laws or bond issues by which the department's money is raised. As a result, we have for two or three years past seen certain states openly committed to building practically nothing but cement concrete roads, others committed to bituminous roads; while in states where the counties are practically supreme in road matters, we find all types and variations of surfacing adopted, each as the only one which the highway authorities then in charge will permit on work under their control.

In urging the adoption by highway authorities of their respective types, some propagandists have gone so far as to claim that their type is recommended by the Bureau of Public Roads or the only one that would be granted federal aid, but Mr. McDonald has positively denied any such preference on the part of his bureau.

As Mr. McDonald's statement so clearly expresses it, there is no best type of road. Every type that has been accepted by responsible engineers has its advantages under certain conditions. These conditions include the traffic and the kind and abundance of road materials locally available, and the financial condition of the state or county is justifiably taken into consideration in many cases.

Only after the conditions affecting a given road have been thoroughly investigated and carefully considered by a road expert competent to make decision, can it be known what kind or variation of road surface will be best for a given section or road, and for legislators to endeavor to decide what type of road shall be used exclusively in their state or county is to make probable the practical wasting of a greater or less percentage of the funds that they contemplate spending.

Engineers for Public Positions

Two resolutions adopted by the American Association of Engineers at its recent convention in Buffalo will meet with the approval of most of the profession, not from any selfish motives, but because of their belief that it would be for the best interests of the people at large. One of these was an urgent suggestion that at least one practical highway engineer be named on the proposed Federal Highway Commission to have charge of Federal Aid highway work, and the other that the existing laws of New York state be changed so as to permit the appointing of engineers as public health officers. At present the New York state law requires all such officers be physicians.

As to the latter, it is now so well established and recognized by those competent to judge that a large part of the duties of health officers lies much more fully in the field of engineering than in that of medicine, that the logic of the situation would call for the appointing of an engineer rather than of a physician. Best of all, of course, would be an engineer who has been specially educated to act as a health officer.

Engineers are specially desirable where the health officer is given charge of refuse collection, as is still the case in a number of places. Much of the unsatisfactory condition of both the collection service and the final disposal of refuse in the past was due to the fact that it was largely in the charge of physicians, the experience and temperament of which, as a class, is generally unsuited to such work; while the recent considerable advance made in both of these lines of work can be traced directly to the recognition of this fact and the placing of such work in the hand of engineers.

As to the matter of requiring a practical high-

way engineer on the Federal Highway Commission, there are arguments in favor of the stand that what is needed in such a position is administrative rather than engineering ability, engineers being employed to furnish the necessary technical knowledge. In reply to this, however, it may be said that some of our best administrative and executive talent can be found among engineers, and that by appointing one who combines ability in both lines, considerable time that would otherwise be lost in educating the commissioner to an understanding of engineering ideas, and friction due to misunderstanding, could be avoided.

Publicity for Public Work

The city engineer of Ogden, Utah, Joseph M. Tracy, shows his appreciation of the importance of giving contractors plenty of time to study plans and conditions before submitting bids, and of reaching all who would be likely to bid by announcing the work through the columns of a paper read by contractors. The city is to let a contract for about six miles of 42-inch to 60-inch sewer, and the legal notice will be published in a few weeks in one of the local papers. But advance notice is given in our advertising pages that the plans are now ready and can be examined. Incidentally, contractors will be paid in cash—as they always should be, but a few cities still follow the undesirable practice of making payment in paper that the contractor must discount.

The same excellent judgment was shown by the water department of Columbus, Ohio, which about a month ago gave notice that bids would be received in about two months for enlarging the water purification works and that plans were then ready, but that the legal advertisement would appear in the "City Bulletin" only.

Cities that give only a few days' notice in local papers of extensive contract work are almost sure to suffer financially in consequence. The bidders will probably be confined to local contractors who have had earlier information and who, in the absence of outside competition, will probably not sharpen their pencils very fine in estimating, or if there are bidders who have not had previous information about the work, they will bid high enough to cover incompleteness of investigation, or if they bid low are likely to be of the irresponsible kind that too often end in financial disaster to themselves and long delays and lawsuits for the city.

New York Loses Passaic Valley Sewer Suit

For thirteen years the city of New York has been fighting the Passaic valley sewer in the courts. Early in May a decision was handed down by the United States Supreme Court refusing the city's application for an injunction to prevent the building of the sewer. This sewer is being built to intercept the sewage now reaching the Passaic river, which is estimated at about 360,000,000 gallons a day, and to discharge the same through a long subaqueous outlet into the upper bay of New York harbor.

At the outset the United States took part in order to protect the federal interests in the harbor, but withdrew on receiving a stipulation from the Passaic Valley Sewerage Commission that it would construct a purification plant on the Newark meadows, this plant to consist of coarse screens, grit chambers, self-cleansing mechanical screens having clear openings of not more than .4 of an inch, followed by final clarification in sedimentation basins. These basins would be 225 feet long and have a capacity such as to provide a detention period of not less than one hour at the maximum rate of flow of the sewage and of not less than one and a half hours on the daily average flow, with mean lineal velocities through the tanks of not over 0.5 inch and 0.75 inch, respectively; the basins to contain scum boards and devices for removing the retained scum and deposits. The sewage so clarified was then to be pumped under pressure through a tunnel to a point in New York bay near Robbins Reef light, where it would be discharged through outlets 40 feet or more beneath the surface, there being not less than 150 outlets located in four or more discharge pipes extending across the current and spaced about 100 feet apart, the outlets being not more than one foot in diameter and arranged to discharge horizontally across the tidal current; the outlets covering a dispersion area of at least 3.5 acres. The commission also agreed that, through use of the plant just described or other provisions that might prove necessary, the Passaic Valley sewage would not be permitted to cause any visible suspended particles in New York bay, or deposits objectionable to the Secretary of War, or odors due to the putrefaction of organic matter, or any grease or color on the surface of the bay, or injury to the public health, or injurious effect upon the property of the United States situated on the harbor of New York, or reduction in the dissolved oxygen contents of the waters of the bay to such an extent as to interfere with major fish life. Also that the United States should at all times have full opportunity to inspect the sewer system with a view to determining whether the contract is being performed.

This stipulation was objected to by New York City on the ground that it would be impossible to show whether any pollution of the harbor was due to Passaic Valley sewage or that from other sources, and it continued the fight in the courts. The Supreme Court in its decision holds that the stipulation with the United States is sufficient to prevent pollution of the harbor, but, in case such pollution should occur, it gives permission to New York to make another appeal for an injunction.

The court stated that, considering all of the evidence submitted, it failed to be convinced that "the sewage which the defendants intend to discharge into upper New York bay, even if treated only in the manner specifically described in the stipulation with the United States government, would so corrupt the water of the bay as to create a public nuisance by causing offensive odors or unsightly deposits on the surface, or that it would seriously add to the pollution of it."

The court makes a pertinent suggestion for co-operation in the following words: "We cannot withhold the suggestion inspired by the consideration of this case that the grave problem of sewage disposal presented by the large and growing population living on the shores of New York bay is one more likely to be wisely solved by co-operative study and by conference and mutual concession on the part of representatives of the states so vitally interested in it than by proceedings in any court, however constituted."

The Passaic Valley sewer is now practically completed, including the purification plant, except for the outlet into the harbor. Two contracts have already been let for this and abandoned by the contractors and it is a question when the outlet will be completed or whether it ever will be, and how great the cost will be. Undoubtedly the cost will be very much larger than was originally estimated. This entire outlet could be eliminated by discharging the sewage into Newark bay, and if the sewage were sufficiently purified this should cause no objectionable results. However, the dilution capacity of Newark bay is by no means so great as that of New York bay, since there is very little change of water due to tides, and the currents through it caused by tributary streams are not great.

One of the arguments used by New York was that if no nuisance would be created, New Jersey might discharge the sewage into Newark bay, against which New York could not object. It is possible that the difficulty and expense of the outlet may still cause the commission to adopt this plan, temporarily at least, leaving it to the future to decide whether, if Newark bay should show injurious effects from this discharge, the remedy should be a further purification of the sewage or the construction of the outlet into New York bay.

On the other hand, New York is asked to answer the question why she herself should not be called upon to treat the sewage being discharged from New York into the bay, which is many times that to be brought by the Passaic Valley sewer and which has already driven from the harbor all of the major fish life which the Passaic Valley Commission stipulated with the United States that it would not interfere with.

The suit has been very expensive, having cost New York more than $152,000, including employing the present Secretary of State, Charles E. Hughes, to represent it before the Supreme Court, while George W. Wickersham, formerly Attorney General of the United States, argued for New Jersey. The testimony taken amounted to about 2,500,000 words and 260 exhibits were put before the court. The printing cost New York $20,000, there being 12 large volumes of text, maps and diagrams.

This probably terminates any legal delays to the completion and use of the Passaic Valley sewer, which has been under construction for so many years. In addition to the engineering and financial questions already referred to, there still remains to be settled whether or not certain of the smaller communities in the Passaic Valley will utilize this sewer and join in paying for it. When it finally comes into use there will probably be considerable disappointment among those who expect to see the Passaic river returned to its original purity and transparency. There are many feet of sewage mud in the bottom of the river which will continue to putrefy for some time to come, and in addition to this, the sewer will not intercept from the river the discharges from many silk mills which contain spent dyes and other impurities that will continue to keep the river dark-colored even though they do not endanger the health of the communities lower down by contributing pathogenic germs or putrescible matters.

The Earth Concrete Road

A new variety of road is offered to highway officials, having first been brought to public notice at the Road Builders' show in Chicago this year. It is known as "earth concrete." A demonstration section of road was laid just outside of Grand Rapids last July. The process calls for mixing five parts of clay, sand, gumbo, muck or soil free from vegetable matter, which must be pulverized, with one part of Portland cement. The water used has dissolved in it 4 ounces of a chemical called "earthcrete" for each sack of cement, sufficient water being used to moisten each particle of the batch. This is laid like concrete, but is allowed to set longer than is customary for concrete. It is recommended especially as a substitute for concrete as a base for brick, asphalt or other wearing course, although the section laid near Grand Rapids is subjected directly to the wear of traffic. A sample of this road was cut out and sent to the Structural Material Research Laboratories of Lewis Institute, Chicago, where a compression test was made of 5 small blocks that were made from the sample, with the result given in the following report:

STRUCTURAL MATERIAL RESEARCH LABORATORIES
Lewis Institute, Chicago, Ill.

COMPRESSION TESTS OF EARTH CONCRETE, TAKEN FROM KNAPP ROAD,
Grand Rapids, Kent County, Michigan Lot No. 5035

Four small blocks were made and tested in a 40,000-lb. Riehle testing machine; one larger block was crushed in a 200,000-lb. Olsen testing machine.

Ref.	Dimension	Height	Sq. In. Loaded Area	Total Load	Unit Load Sq. In.
No. 1	2.50x2.85	3.6	7.12	13,450 lbs.	1890
No. 2	3 x3.05	3.3	9.15	21,160 lbs.	2310
No. 3	2.75x3.05	2.9	8.38	14,350 lbs.	1710
No. 4	2.80x2.85	4.2	7.98	14,785 lbs.	1850
No. 5	6.40x7.3	4.3	46.8	111,300 lbs.	2380

Average of 5 blocks, 2,030 lbs.

April 14, 1921. Correct (Signed) S. WALKER,
Approved, Prof. in Charge of Laboratory.

On May 4, the test road mentioned was inspected by a party containing Alvah Brown, chairman of the Kent County Road Commission and president of the of the Earth Concrete Company; Rial V. McArthur, member of the Kent County Road Commission; O. S. Hess, engineer of that commission; E. J. Paas, superintendent of road maintenance of the county; and H. J. McKinley, secretary of the commission; also Clifford Paige, city engineer of Grand Rapids; L. H. Belknap, chief engineer, and C. E. Foster, district engineer of the state highway commission; and R. S. Greenwood, secretary-treasurer of the Earth Concrete Company.

WORK DONE DURING 1920 AND CONTEMPLATED DURING 1921 (Continued)

County and State	During 1920: Money spent for hwy. work	During 1920: Kind and amount of surface laid	During 1920: Amt. done by contract & by employees C—contract E—employes	During 1921: Money available for hwy. wk.	During 1921: Kind & amt. of surface to be laid	Amount to be done by contract and by employees C—contract; E—employees
Oregon (continued):						
Polk	.....	16 hard surface, 10 gravel & m.	....	75,000	.....	.....
Sherman	31,000	1½ mac., culverts	all E	45,000	3 mac.	all E
Wheeler	225,000	175,000 dirt, 50,000 crushed rock	all C	200,000	100,000 crushed rock, 75,000 dirt	all C
Yamhill	700,000	14 conc., 11 bit.	110,000 E 590,000 C	350,000	grading, 18 conc.	102,000 E, state work C
Pennsylvania:						
Allegheny	.....	19,808 war.-bit.	....	.....	.....	.....
Armstrong	80,000	1 brick, 1 conc.	all C	1,450,000	20 conc.	all C
Bradford	.....	31,702 war.-bit.	....	.....	.....	.....
Centre	.....	23,208 war.-bit.	....	.....	.....	.....
Delaware	.....	47,265 war.-bit.	....	.....	.....	.....
Erie	455,044.44	con.	all C	1,000,000	46 conc.	all C
Monroe	600,000	13 conc.	all C	500,000	mac., 5 conc.	5 mac. E
Potter	50,000	conc.	all C	50,000	8 conc.	all C
Warren	120,000	3 conc.	all C	200,000	1½ conc.	all C
Rhode Island:						
Bristol	22,000	½ topeka, 2 gravel	all E	30,000	7 gravel	all E
Providence	3,000	none	....	3,000	75 gravel	all E
South Carolina:						
Greenwood	540,000	1 conc., 107 topsoil	all C	608,000	1 conc., 60 topsoil	168,000 maint. E, 440,000 C
South Dakota:						
Clay	40,000	dirt	4,000 C, rest E	.....	$50,000-60,000 dirt	all E
Codington	53,000	9 gravel, 8 earth	45% E 55% C	38,000	10 earth	all E
Corson	103,000	48 earth	15,000 E, 88,000 C	30,000	24 earth	all C
Custer	260,000	2 crushed granite	all E	300,000	.....	30,000 E, 10,000 C
Davison	120,000	10 gravel, rest dirt	all E	160,000	8 gravel, 25 dirt	8 C, rest E
Day	234,989.84	earth roads	80,614.06C rest E	175,000	28 gravel, earth	60% E, 40% C
Gregory	100,000	1 gravel, rest earth	60,000 E earth, bridge C	200,000	earth, clay or sand	70,000 E, 130,000 C
Haakon	90,000	1,000 dirt rd.turnpiked	all E	150,000	100 dirt, 10 gravel	all E
Hanson	90,000	$22,000 gravel hwy., 6 earthwork	all E	175,000	finish 1920 proj. dirt	all E
Jackson	160,000	8 grav., rest earth	earth moving C rest E	25,000	100 earth	nearly all E
Lincoln	278,000	20 gravel, bridges	grading & maint. E 226,000 C	380,000	25 gravel, maint. & grading	maint. & grad. E, grading for grav. & bridges C
McCook	72,000	gravel and dirt	36,000 E 36,000 bridgework C	200,000	25 gravel, maint., bridge work	¼ E, rest C
Miner	150,000	11½ gravel, 54½ clay	clay E gravel C	42,000	75 clay	all E
Minnehaha	280,000	39 gravel	all C	350,000	45 gravel	10 E, 35 C
Perkins	70,000	earth	20,000 E, 50,000 C	20,000	earth	all E
Spink	130,000	earth	all E	100,000	earth	all E
Stanley	80,000	53 dirt	48 E, 5 C	70,000	20 dirt	10 E, 10 C
Tripp	180,000	earth	100,000 E 80,000 C	165,000	18 grading	10% E, 90% C
Union	182,000	18 gravel	all C	60,000	18 grading & gravlg.	all C
Walworth	140,000	dirt	40,000 E, 60,000 C	90,000	dirt	all E
Yankton	80,000	grading	all E	300,000	grading	20,000 E, 280,000 C
Tennessee:						
Bedford, Coffee and Moore	100,000	5,000 gravel, 36 000 mac.	all C	1,200,000	8 mac., 35 bit. mac.	all C
Benton	60,000	grading	all E	60,000	.....	all E
Coche	100,000	mac.	all E	50,000	25,000 mac., 15,000 grade, 10,000 mac.	all E
Giles	200,000	40 gravel, 5 grade	40 E, 5 C	600,000	60	40 gravel E, 20 bit. C
Greene	100,000	20 earth, 32 mac.	all C	470,000	51 mac., 113 earth	all C
Hamilton	250,000	4 conc., 15 chert	all E	300,000	8 conc.	all E
Lewis	60,000	graded earth	10 E, 15 C	30,000	20 earth	all C
Lincoln	none	none	....	370,000	15 miles	all C
McMinn	22,000	4 chert, repairs	all E	56,000	14½ conc.	all C
Monroe	40,000	12 dirt	all C	800,000	35 asp. pen., mac. & grading	all C
Tipton and Lauderdale	108,225	13 grading	all C	328,918	13 bit. mac.	all C
Texas:						
Arkansas	38,000	10 sand clay, 25 earth	all C	62,000	25 shell surfacing	all C
Bosque	80,000	gravel	all E	60,000	10 gravel	all E
Callahan	120,000	none	20,000 E, 100,000 C	60,000	36 gravel	all C
Cameron	50,000	earth	all E	550,000	12 conc. pavement	all C
Carson	15,000	dirt	none E, little C	15,000	dirt	none E, little C
Colorado	330,000	35 gravel, 1 conc.	all C	50,000	4 gravel	all C
Dickins	86,983.94	14 gravel	all C	30,000	6.5 gravel	all C
Edwards	12,000	none	....	100,000	.....	all C
Fort Bend	60,000	grading	all C	200,000	$40,000 for grading, rest undetermined	all C
Gonzales	400,000	40 gravel	all C	277,750	12 mi. proj.	all C
Harris	400,000	2 conc., 15 mac., 5 bit. top.	all C	375,000	20 retreatment, repr.	all C
Johnson	200,000	gravel	all C	200,000	54 fed. aid	all C
Limestone	300,000	5 gravel, 90 grading	all C	1,000,000	55 gravel	5 E, 10 C
Madison	75,000	20 earth	all C	125,000	15 earth	all C
Milam	475,000	gravel	all C	410,000	all gravel	all C
Montague	300,000	44 gravel	all C	50,000	finish 1920 work	all E
Robertson	75,000	8 gravel	all E	.....	23½ Dixie Hwy.	all C
Rockwall	50,000	grading for conc.	all C	600,000	500,000 conc., 100,000 earth & bridges	all C
San Augustine	250,000	12 gravel	all C	300,000	21 gravel	.....
Shackelford	40,000	6 gravel, 10 earth	25,000 E 15,000 C	23,000	.....	500,000 E, 1,500,000 C
Tarrant	300,000	drainage structures & grading	15,000 E 285,000 C	3,775,000	2,000,000	

WORK DONE DURING 1920 AND CONTEMPLATED DURING 1921 (Continued)

County and State	During 1920: Money spent for hwy. work	During 1920: Kind and amount of surface laid	During 1920: Amt done by contract & by employees C—contract E—employes	During 1921: Money available for hwy. wk.	During 1921: Kind & amt. of surface to be laid	During 1921: Amt. to be done by contract and by employes C—contract E—employes
Texas (continued):						
Trinity	30,000	.....	all E	500,000	20 grav., 50 sand clay	all E
White	10,000	mac.	all E	600,000	mac.	all E
Wise	160,000	17 rock and gravel, 17 earth, 1 clay	3 clay E rest C	120,000	2½ gravel, 23 drainage structures, 71 maint.	mainten. rest C
Utah:						
Pleasant	.....	22,185 war.-bit	....	.....	.....	....
Salt Lake	.....	142,776 war.-bit.		.....	.....	....
Vermont:						
Bennington	196,638	.3 conc., 5.2 gravel 1.4 conc. base w. asp.	gravel town rest C	372,000	5 conc., 13 gravel	6 gravel towns, rest C
Orange	117,000	2½ bit. mac., rest gravel	$2,000 E 35,000 C	50,000	gravel	all E
Windham	92,000	gravel	62,000 E, 30,000 C	.....	.....	.....
Virginia:						
Augusta	150,000	8 mac.	75% E 25% C	450,000	23 mac.	50% E, 50% C
Brunswick	130,000	40 soil	40,000 E 90,000 C	80,000	20 soil	all C
Campbell	200,000	20 soil, 5 mac., 5 bridges	all C	346,000	59 soil, 6 bit. mac.	all C
Fairfax	43,000	mac.	all E	760,000	8 mac., possibly 23 more	all C
Nansemond	300,000	5 conc., 15 sand clay, 15 gravel	5 conc. C rest E	200,000	4½ conc., 10 sand clay & gravel	10 E, 4½ C
Scott	150,000	mac. & gravel	90,000 E 60,000 C	300,000	.....	175,000 E 125,000 C
Washington:						
Adams	1,000,000	86 gravel & rock 33 dirt	7½ E 78½ C	530,000	24.5 crushed rock	all C
Benton	.....	10 mac.	3 E, rest C	70,000	25,000 fills & mac. top	all E
Clallam	230,000	gravel	50,000 E 180,000 C	190,000	gravel	10 E, 12 C
Clarke	1,000,000	16 conc., 13 bit.	all C	315,000	7 conc.	all C
Grant	220,000	50 gravel	23 E, 27 C	300,000	60 gravel	24 E, 36 C
Island	39,350	4 gravel	1½ E, 2½ C	46,500	2½ per. hwy., 6 grav.	6 E, 2½ C
Jefferson	90,000	46,000 gravel	4,000 E, 42,000 C	98,000	40,000 gravel	1,500 E, 38,500 C
Kittitas	.....	27,070 sq. yds. conc., 1.2 mac.	....	.....	6 mac.	....
Lincoln	601,000	56 crushed gravel	141,000 E rest C	261,000	23 grading & gravlg.	11 E, 12 C
Okanegan	125,750	10 grading & graveling. 17 graded, 2 bridges	17 grad. E rest C	150,000	12 grading & gravlg.	all C
Pierce	.....	18,814 war.-bit.	....	.....	.....	....
Snohomish	600,000	300,000 conc., 300,000 gravel	200,000 E 400,000 C	725,000	350,000 conc., 100,000 brdg., 275,000 grav.	150,000 E 575,000 C
Wahklakum	4,037	crushed rock	all E	3,553	Ocean Beach Hwy.	all E
Yakima	.....	117,740 war.-bit.	....	.....	.....	....
West Virginia:						
Boone	255,754.82	grading, draining & bridges	25,000 E rest C	300,000	grading, draining & bridges	all C
Brooke	338,000	6½ mac., 2 conc., 12 grading, 3 base	rest C 3 grading E	320,000	¾ conc., 10 bit. mac.	¾ conc. C, rest E
Cabell	100,000	1 grading, ½ conc. 2½ brick	all E	.....	..... reconst.	.....
Calhoun	35,000	grading & drainage	all C	.....	25,000	all C
Hardy	35,000	gravel, mac.	all E	40,000	6 surface treatment, 5 gravel mac.	all E
Kanawha	.....	1.5 conc.	....	.....	14 conc., 4 mac.	....
Mercer	170,000	8 grading	all C	100,000	6 grading, 3 bit. mac., reconst.	maint. E, grad. C
Mineral	151,006	21 000 sq. yds. mac.	all E	121,000	11 grading	all C
Morgan	79,000	1 1-3 conc.	all C	116,000	18 earth	all E
Nicholas	78,767.67	10 earth	all E	20,000	little	all E
Ohio	268,000	1 brick or conc., 3 mac.	mac E rest C	Indef.	.....	all C
Pocahontas	90,000	1½ mac., 10 grading	all E	120,000	grading	all E
Randolph	200,000	5 conc., 3½ tarvia, 1½ mac.	tarvia, mac. E conc. C	250,000	10 mac.	all C
Summers	170 210	1.9 pen. mac., bridge	surfacing E rest C	275,500	20 grading	5 E, 15 C
Taylor	none	.....	....	300,000	13 hard surfacing	all C
Wayne	654 19? 78	2 brick, 46 earth	all C	400,000	.....	maint. E, rest C
Webster	50,000	earth	40,000 E, 10,000 C	150,000	grading	all C
Wetzel	215,000	1¾ conc.	all E	300,000	9 grading, 5 hard sur.	Indef.
Wisconsin:						
Adams	50,000	6½ clay	2 E, 4½ C	75 000	10 clay	3 E, 7 C
Bayfield	101,265 73	6 sand surfacing	all E	311,000	$300,000 sand surfac.	all E
Calumet	165,000	4 conc., 4 mac., 3 gravel	4 conc. C rest E	300,000	5 conc., rest mac. & gravel	5 C
Dunn	30,000	gravel	15,000 E, 15,000 C	200,000	4 conc., clay & gravel	20,000 E, 160,000 C
Forest	153 000	dirt	all E	257 945.46	dirt, gravel	.....
Grant	165,000	9 gravel, 1 mac. ¾ tarvia mac.	all E	500,000	grading & draining	150,000 E, 350,000 C
Iron	70,000	4 gravel	40,000 E, 30,000 C	147,000	8½ gravel	all E
Jefferson	.....	20 gravel	18 E, 2 C	350,000	15 conc., 15 gravel	gravel E, conc. C
Juneau	80,000	20 clay	1 1-6 C, rest E	90,000	clay, gravel	all E
La Cresse	255 840 27	15 bit.	all E	325,311.84	30 pen.	all E
La Fayette	130,000	earth	90,000 E 40,000 C	200 000	24	all E
Lincoln	120,511.36	gravel & grading	100,500 E 20,000 C	150,000	gravel & grading	100,000 E, 50,000 C
Natrona	541 000	1 bit.	....	225,000	.....	25,000 E
Portage	145 000 87	17 granite, 23 gravel	all E	294,000	6 conc., 24 gravel	24 E, 6 C
Riverside	65 798 ??	4 6 mac., 1 conc.	3 E, C	157,054.52	.....	2 E, 4 C
Sauk	190 000	6 lime rock, 16 gravel	all E	235 000	18 lime rock, 9 gravel	all E
Trempealeau	450 000	gravel & mac. grading	100,000 E 250,000 C	350,000	175,000 grading, 75,000 gravel surfacing 50,000 mac.	most C

WORK DONE DURING 1920 AND CONTEMPLATED DURING 1921 (Continued)

County and State	During 1920: Money spent for hwy. work	During 1920: Kind and amount of surface laid	During 1920: Amt. done by contract or by employees C—contract E—employees	During 1921: Money available for hwy. wk.	During 1921: Kind & amt. of surface to be laid	During 1921: Amount to be done by contract and by employees C—contract; E—employees
Wisconsin (continued):						
Vernon	223,000	3 bit.	all E	250,000	3 bit.	all E
Waushara	65,000	gravel	45,000 E 20,000 C	135,000	19 gravel, ¼ conc.	85,000 E, 50,000 C
Wyoming:						
Weston	50,000	40 earth	20 E, 20 C	85,000	10 gravel, 150 earth	earth E, gravel C
Arkansas:						
Washington	350,000	gravel only, 80 grade, 20 finished road	none E 80 C	500,000	100 gravel	all C
California:						
San Benito	123,938	(a) 8 surfacing with oil & screening, 5 W. B. mac.; 3 oil bound mac.	13 E 3 C	150,000	.....	all C
Colorado:						
Fremont	70,000	25 gravel	all E	164,843	12 gravel	10 E, 2 C
Lake	10,000	5½ gravel, bridge	all E, except bridge C	6,160	maint.	all E
Delaware:						
New Castle	500,000	conc. & bitoslag	all C	500,000	.....	all C
Idaho:						
Benewah	140,000	none	80,000 E, 60,000 C	165,000	8 mac., 10 dirt	2 E, 18 C
Washington	.....	.....	....	.....	35 miles	all C
Indiana:						
Hendricks	300,000	4 1/6 conc., 6½ mac., 6½ grav.	all C	350,000	3½ gravel, 7 mac.	all C
Martin	50,000	mac.	all C	Indef.	15 stone	all C
Orange	50,000	mac., $20,000 bridges	all C	150,000	mac.	all C
Spencer	85,000	13 gravel	all C	800,000	.....	all C
Iowa:						
Jasper	114,000	$42,000 earth	all C	100,000	$150,000 earth, $50,000 gravel	200,000 C
Kansas:						
Butler	200,000	dirt	....	200,000	.....	....
Clark	28,500	earth	all E	24,000	4 clay on sand, rest maint.	all E
Kentucky:						
Carroll	2,000	.....	all E	.....	5 gravel	all E
Massachusetts:						
Middlesex	12,000	asp. mac.	....	4,000	asp. mac.	8,000 ft. C
Michigan:						
Washtenaw	500,000	1½ conc., 2¼ asp., 11 gravel	all C	1,000,000	16 conc. 23½ gravel	16 E, 23½ C
Minnesota:						
Martin	181,977	.....	....	150,000	17 earth, 10 gravel	11 earth, 10 grav. E, 6 earth C
Pine	188,125.44	31 grading, maint. & repair	28 E, 3 C	77,779.09	10 grading & gravel surfacing, 2 grading	all C
Wadena	40,000	.....	$30,000 E, $10,000 C	85,000	1-2 sand clay	most E
Mississippi:						
Lee	334,620	grading bridges & culverts	all C	.....	paving	all C
Missouri:						
Perry	18,000	3 rock & gravel	all E	24,000	rock & gravel	all E
New York:						
Saratoga	60,000	14 gravel, 2 bottom course for bit. mac.	all E	.....	$75,000 bit. macadam, gravel & concrete	all E
North Carolina:						
Cherokee	.....	.....	....	400,000	Indef.	Indef.
Macon	none	.....	....	800,000	.....	....
North Dakota:						
Foster	2,644	6½ graded road	all C	.....	10 grading	all C
Hettinger	200,000	dirt	65,000 E, 135,000 C	Indef.	mostly blade work	small amt. E, nearly all C
Williams	50,000	70 earth	most E, 4 C	100,000	73 earth	60 E, 13 C
Oregon:						
Washington	612,000	30 earth, 37 mac., 7 bit.	7 C, rest E	763,000	6.7 bit., 30 mac., grad.	rock quarries only C, rest E
Pennsylvania:						
Susquehanna	.....	.....	....	180,000	5 conc.	all C
Wyoming	none	none	none	.....	10 conc.	all C
South Dakota:						
Beadle	250,000	62½ grading, 39¼ fills, 2½ gravel, 46¾ rebladed	all E	533,000	50 grading, 75 reblade work, 20 gravel	all but fed. aid E, fed. aid C
Sully	35,000	$20,000 earth, $15,000 gravel	all E	85,000	800,000 earth, 5,000 gravel	35,000 E, 50,000 C
Texas:						
Comanche	60,000	8 earth	6½ grading C rest E	375,000	25 gravel, 28 grading & bridging	all C
Hill	1,000,000	gravel	all C	1,500,000	gravel & bit. surface	all C
Virginia:						
Pittsylvania	300,000	90,000 conc., 105,000 soil, 25,000 bit. mac.	all C	230,000	4 bit. mac., 20 soil. maint.	all C
Washington:						
Pacific	345,000	66,000 cem. conc., rest grading and draining	all C	352,000	5 cem. conc., 17 grav. & grading	all C
Skamania	52,000	3 mac.	all C	190,000	4 miles	all C

a During 1919 and 1920.

American Bids asked for $30,000,000 Work in Australia

Premier John Storey, of New South Wales, who is in this country, announces that American contractors will be asked to bid on a subway system for railway, tramway and vehicular traffic to cost $30,000,000. The government is also planning to build a bridge across Sydney harbor which will cost $15,000,000.

Both of these contracts should appeal to American contractors and be especially advantageous to them on account of their international preeminence in bridge construction and their unapproached successful experience in difficult subway construction.

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems differently will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

What Are the Best Methods of Handling Gravel from Car to Concrete Mixer?

By gravity alone, when conditions are favorable. By mechanical equipment and gravity combined or by mechanical equipment alone. Clam-shell, orange-peel and even drag-line buckets, derricks, gantries, locomotive cranes, belt and bucket conveyors, elevated bins, dump cars and chutes, are most common items of plant installed. Small amounts can be handled entirely by hand.

When large amounts of gravel to supply concrete mixing machines are delivered by railroad cars the most satisfactory and desirable method of unloading the cars is generally closely related to the method of storing the gravel after it is unloaded and of measuring it and delivering it to the concrete mixer, most rapidly, conveniently, and economically.

As in many other construction problems, some of the most important considerations are the amount of material to be handled, the speed required, the permanency or temporariness of the work, relative cost of hand labor, the cost and efficiency of hand labor, availability of mechanical plants and the ability to make the necessary investment to secure the greatest ultimate economy.

It may be cheaper to handle a comparatively small amount of material at a very high unit cost without any permanent installation, than to handle the same amount of material at a low unit of cost for direct operations plus a heavy cost for installation of plant that will not be useful or saleable after the completion of the given work.

Intermittent operations, limited progress, conflicting interests or other reasons may also make it much more advantageous to adopt certain methods and plants that involve a direct high unit cost or even a high total cost, rather than others that may show considerable economy regarding the gravel itself and yet involve objectionable features in connection with other parts of the work. These considerations must be carefully studied and balanced for any particular case.

The suggestions which follow refer solely to the intrinsic merits of various features of established practice which must be selected and applied in accordance with the circumstances and local requirements. The facts referring to gravel apply in large measure to broken stone and sand and in some degree to coal. They do not apply to cement because it must be carefully handled and scrupulously protected against moisture.

GRAVITY METHODS

The ideal method of unloading, storing and handling gravel would be its delivery in bottom dump cars, hauled on a track at the top of a steep bank or incline or on a trestle that would enable it to fall without guidance or to be chuted into an elevated storage bin or to storage behind a bulkhead on an inclined surface thus permitting the gravel to be drawn by gravity through a gate at the bottom of the bulkhead.

From storage the gravel should be spouted through a valved chute to the mixer and there discharged into measuring boxes or into the gauged charging hopper itself, and from it delivered to the machine. If the gravel cannot be chuted directly from storage to mixer it may be delivered at storage to batch boxes, buckets, measuring cars, or dump cars on an incline where the loaded cars pull back the empty ones and carry the gravel a considerable distance to the charging hopper of the mixing machine.

In some cases it might be good policy to use an all-gravity installation even if it resulted in the location of the concrete mixer at an elevation below all or a portion of the work so that it became necessary to hoist the concrete to the top of a tower and thence spout it to position.

COMBINED GRAVITY AND MECHANICAL INSTALLATION

Gravel delivered in dump cars may be unloaded by gravity without any mechanical appliances whatever, no matter whether they are dumped at a high or low elevation relative to the position of the concrete mixer and the ultimate storage pile. When it is not dumped at an elevation and position enabling the gravel to flow by gravity to storage as already described, it can be handled from the dump to storage by mechanical appliances and afterwards be delivered from storage to the mixing machine by gravity or by mechanical equipment. It will usually be economical to arrange the elevation and position of the storage so as to make all of the subsequent transfers to the concrete mixer by gravity alone.

If the gravel is dumped into a track pit or hopper or into piles of limited dimensions temporarily

stored alongside the track it can be transferred from this temporary position to the storage bin by belt or bucket conveyors, by excavating buckets operated by derricks, gantries, or their equivalents, by loading machines, by loading machines and dump cars combined, by locomotive cranes or traveling derricks.

Excavating machines of various sorts, especially the lighter ones may be adapted to handling the gravel in this case. These machines, loading machines and the conveyor machines will operate only in the storage yard and are not available for directly unloading the cars. The other methods are also available for unloading the cars and for filling adjacent storage bins at the same time and therefore will be here considered only in relation to the unloading of the cars.

UNLOADING CARS

If the cars are not dump cars or if the track is not elevated above the top of the storage pile or has not a hopper underneath it will be necessary to unload the gravel by scooping it out of the car. For small quantities or in emergencies this can always be done by men with shovels, an operation which is slow and costly at best and particularly so in very small cars or with gondola cars having high sides, especially if it is necessary to deliver the gravel to a single truck or other small receptacle, thus limiting the number of shovelers.

When hand shovelers are necessary it is often advantageous to use shovelers' chutes, which are simply inclined troughs supported on the edge of the car side and a trestly or other convenient support at the opposite end, thus carrying the gravel away from the car and delivering it into the truck in a convenient position or to a storage bin clear of the track. Convenient steel unloading chutes are to be had in the market and home-made chutes can also be easily provided if necessary.

For unloading a large quantity of gravel from non-dumping cars mechanical apparatus should be provided and usually consists of some sort of a scoop or bucket operated by a hoisting tackle suspended from a boom, elevated support or some sort of movable carriage, so as to have command of a sufficiently wide area to enable it to deliver to permanent storage or at least to a reloading bin, from which, if necessary, it can be spouted to cars or trucks for further transportation.

A desirable arrangement is to have the same bucket deliver to an elevated storage bin of moderate capacity and also to a surface storage pile where the gravel can be deposited when the bin is full and from which it can be reclaimed by the same bucket to fill the bin as it is emptied. The storage pile should, in any event, be located so as to be commanded by the same bucket that operates from the car and if the storage bin cannot be commanded by the same bucket another one may be provided to fill the bin from the storage pile.

BUCKETS

There are on the market various types of steel automatic buckets that fill themselves without shoveling, such as the clam-shell, orange-peel, grab bucket and even the drag-line or scraper bucket, that are suitable for handling the gravel. Clam-shell buckets are the simplest, and usually the most desirable and convenient. The drag-line bucket can reclaim the gravel from the storage pile, but can hardly remove it from an ordinary car. Most of the ordinary types of buckets can be purchased in sizes varying from ¼-yard to 2-yards capacity; the ½-yard, ¾-yard and 1-yard are suitable for ordinary light to heavy work, and are also available for ordinary excavation and other transportation purposes besides handling gravel.

If necessary an ordinary wooden or steel bucket may be used when excavating buckets are not available. It can be filled by shovelers stationed in the car and may be emptied by tilting or through bottom-flap doors. The tilting bucket may be operated by a hoisting engine winding up a dump line at a fixed time, or they may be balanced so as to tilt by gravity when unlocked. The bottom-flap buckets are, of course, dumped by releasing the latch either by a hand line or by a stop fixed to operate at a given point.

OPERATING BUCKETS

The buckets can be operated from derricks, locomotive cranes, A-frames, gantries, ginpoles, or even from cableways. Simple A-frames, ginpoles and gantries of a home-made type can be very easily provided, but have a limited radius of operation, especially the A-frame and gantry that provide for a very short horizontal movement of the bucket and that only in a limited direction. For the small amount of gravel that alone would justify the use of these appliances it might be suitable to operate the bucket lines by a hand windlass or crab, but in general a regular hoisting engine or a drum operated by a belt or by a steam, gasoline, electricity or compressed air motor should be provided.

Either guyed, stiff-leg or traveling derricks may be used, according to circumstances and requirements, but ordinarily stiff-leg derricks will be more convenient and efficient for handling a large quantity of material at a given point. The derrick boom should be long enough to serve the top of a conical storage pile having a volume as great as the required amount of storage and to also serve the elevated storage bin or else more than one derrick should be installed or a movable derrick employed. The capacity of the boom need not, however, be more than 5,000 pounds at full radius, unless a bucket of more than 1-yard capacity is used.

Derricks are so universally used for all kinds of building and construction operations that it will generally be possible to secure one in the vicinity, or to purchase one from the manufacturer without much delay or expensive transportation, but it is also practicable to purchase the derrick fittings and rig them to mast and boom made of square timber bought at the nearest lumber yard or even to round timber cut near the site.

Simple derrick fittings can be forged by a country blacksmith and finished in an ordinary machine shop and commercial pulley blocks may be rove with either steel or manila rope if it is

necessary to improvise a home-made derrick, in which case care should be taken to make all parts of excess strength. In most places the masts and booms from 25 to 50 feet long can easily be secured of sufficient diameter and quality to be perfectly safe for ordinary service. A long boom up to 80 or even 100 feet can be made by splicing and trussing shorter timbers, but this should not be attempted unless under urgent conditions and by experienced derrick designers.

A small amount of work involving only short distances, can be satisfactorily performed with jinniwink derricks which are simply small, portable stiff-leg derricks, usually of wooden construction, with booms about 25 feet long and up to 5 tons capacity, operated by hand power or small engines and easily knocked down and shipped from place to place by railroads or trucks, and when in service quickly shifted by skidding on its sills. Any stiff-leg derrick can be made movable to command a long storage pile or to be shifted from the storage pile to the storage bin by mounting the sills on three trucks, preferably having four wheels each, and operated on two parallel tracks, although it is possible to use trucks having only 1 or 2 wheels each and in the same line and running on two rails, making one broad-gauge track instead of two standard or narrow-gauge tracks. In either case one truck must be placed under the foot of the mast and ballast must be loaded over the other trucks to provide counterweights and fixed stability to the derrick in service. A platform is usually built on the sills over the rear trucks to carry the hoisting engine and boiler which thus serve as part or the whole of the required counterweight.

(To Be Continued)

Care of Concrete Mixers*

In most cases the operators of concrete mixers are fully responsible for the upkeep of the machines and are never called to task because the mixer is in run-down condition. If the contractors themselves or a responsible foreman would see to it that their mixers were properly greased, oiled, cleaned, etc., there is no doubt that the mixer's life and efficiency would be materially increased.

Setting Up.—When you buy a mixer, see that it is assembled correctly before starting. Turn down the grease cups, oil the wearing surfaces where necessary, see that the bolts and nuts are tight and be sure everything is all right, then go ahead. Manufacturers always send instructions for setting up, which should be your guide when assembling.

Oiling.—Oil your machine liberally. Give the drum rollers plenty of grease; they have the heaviest duty. Don't forget your engine, either; it needs oil. Follow the engine oiling instructions carefully. Oil the drive chains to make them drive smoothly and endure. Oil all gears, especially bevel gears. Use a good quality of machine oil that will not thicken when cold. Also use a good grade cup grease where grease is required.

Feeding.—It has been found that as far as mixing is concerned, it does not matter in what order materials are fed into the drum. The feeding is done to meet the convenience of the operator. If desired, the old method of hand mixing can be adopted as follows: Sand and cement, then add water and follow with crushed rock or gravel. A good way to get cement in without "dusting" is to put it into a barrow of sand, or still better, to add some water to the batch before putting in the cement.

Where a sharp stone is used in the batch, it is well to put in a portion or all the sand first, as the sand will act as a cushion and protect the shell of the drum. Do not fill the drum too full. A big batch mixes more slowly than a small one. There is a happy medium between best time per batch and best quality, which experiment will determine. Cement mortar or "sloppy" concrete is best mixed in batches of reduced size.

Washing.—Wash out the drum before the mixer is stopped. It is necessary to keep the inside of the drum clean, as only a clean drum will do good work. Fill the drum with water and revolve until it is clean, then discharge the water. If water alone does not clean drum, add a little crushed stone or a few small pieces of scrap iron. If the drum is once neglected and cement allowed to harden inside, it is very difficult to clean.

Blocking.—It is sometimes desirable to block mixers. Do this whenever possible. It not only prevents destructive vibration but saves power and repair bills.

Care of Boiler.—Do not fire hard when the boiler is cold. The type of vertical boiler best adapted to concrete mixers has one weak point, viz., the top ends of the flues are not surrounded by water. In raising steam, the fire should not be crowded until some pressure is shown on the gauge, or the top of the tubes will be overheated and the boiler will surely leak.

Repairs.—Keep your mixer repaired. Don't allow parts to be worn so they affect the operation of the mixer. The minute you notice a worn part order a new one. It will pay you every time. Particularly watch your drum rollers. Replace them as soon as they are worn or become wobbly. Never allow your drum to run untrue. Watch every part and replace it with new one as required.

*By L. P. Lessard, Sales Dept., the T. L. Smith Co., Milwaukee.

To Keep Oil Out of Sewers

City ordinances of Providence, R. I., already prohibit the dumping of highly inflammable materials into the sewers, which includes gasoline, but there seems to be no provision that covers heavy oils and some other objectionable substances. Large quantities of heavy oils are not only permitted to escape into the sewers, but are being actually dumped into them by both public and private garages. A new ordinance providing substantial penalties for those caught continuing this practice has been introduced into council and will probably be passed.

Recent Legal Decisions

CITY'S POWER TO CONNECT BY PAVING THE PAVED PORTIONS OF STREETS—ENGINEERING EXPENSES PROPERLY INCLUDED IN ASSESSING PAVING COSTS

In a suit to enjoin the city of Wichita, Kan., from levying a paving assessment the Kansas Supreme Court holds, Bailey v. Henrion, 194 Pac. 928, that under the Kansas statute (Gen. St., 1915, par. 1236) a city of the first class has power, upon its own initiative and regardless of the attitude of resident taxpayers affected thereby, to pave an intervening portion of a city street to connect portions already paved, if such unpaved portion does not exceed two ordinary city blocks in extent.

Another question was raised by the plaintiffs. Included in the cost of this paving improvement was an item of 5 per cent for engineering expenses. Aside from the physical work of excavation, construction and the furnishing of materials, there is a necessary expense of surveying, making blueprints, supervising the work as it progresses, and inspecting the materials used in making the pavement. Is this a proper charge in calculating the true cost of the improvement? This expense is called "engineering"; sometimes it is called "overhead." Whatever the name, the court holds it is a very necessary item of expenditure. "It would be a very costly economy, indeed, it would be absurd, to undertake an expensive work of paving construction without this 'engineering.' While the city may have an official engineer and pay him an annual salary, yet he cannot do all this work alone. He must have linemen, rodmen, and perhaps other employees, at the particular work or in his office, assisting him; and it must be held that a reasonable charge for this 'overhead' or 'engineering' is properly included in determining the cost of the improvement, and it is proper to take it into account in assessing that cost against the property benefited by the improvement."

ICE IN STREETS—PROPER CARE REQUIRED OF PEDESTRIANS

Action was brought against a city for injuries to a pedestrian who fell as a result of coming in contact with a large ridge of ice, three or four inches in thickness, which extended across the sidewalk and had been there for three weeks. The night was clear, the electric lights were burning brightly on the corner where the plaintiff fell, and the ridge of ice was visible for a considerable distance. The Pennsylvania Supreme Court, Gryning v. City of Philadelphia, 112 Atl. 448, reversing a judgment for the plaintiff, held the city not liable. While a pedestrian is only required to use ordinary care, it is his duty to keep a general lookout, so as to observe dangers directly in his path, and the plaintiff being a young man, with normal eyesight, and with no one near to obstruct his view or distract his attention, could not be heard to say that he was watching his way very carefully and did not see the ridge of ice.

ORDER TO DIRECTOR OF PUBLIC WORKS TO LAY OUT PROPER SEWER HELD NOT UNLAWFUL DELEGATION OF POWER

The public powers or trusts devolved by law or charter upon the council or governing body of a municipality to be exercised by it when and in such manner as it shall judge best cannot be delegated to others; but powers of a purely ministerial, administrative, or executive nature may be delegated to a committee or some appropriate officer. In a proceeding to set aside a sewer assessment, the Connecticut Court of Errors, Donnelly v. City of New Haven, 111 Atl. 897, points out that the correct application of the above rules to cases under specific municipal charters is not always easy. The municipal charter is a delegation of power from the legislative body of the state. Whatever is by such charter required to be done by the governing body of the municipality must, so far as that municipality is concerned, be deemed to be legislative in character, and can only be done by such governing body itself. Hence it is that many matters may be referred by a charter to the action of such municipal body which are really administrative or executive in their character. In a given case the generality or the detail of the power as set forth in the charter must be carefully examined and will furnish the guide as to what powers may and what may not be delegated by the governing body. Applying these principles, the court holds that, since Section 132 of the New Haven Charter merely provides that the board of aldermen is authorized to order, lay out, construct, repair, and alter public squares, parks, streets, highways, sewers, etc., an order that the director of public works cause a sewer to be constructed with specified termini of the proper size and materials, with the necessary manholes, etc., is not an unlawful delegation of legislative power, the charter containing no specific provisions as to sewers.

WASHINGTON COMMISSION CANNOT DENY CITY'S APPLICATION FOR RAILROAD CROSSING

On appeal by the Washington Public Service Commission from a judgment of the Yakima County Superior Court reversing its order denying a petition of the city of Toppenish for the establishment of a grade street crossing over the Northern Pacific tracks in that city, the Washington Supreme Court holds, State v. Commission, 194 Pac. 982, that under Sections 2 and 3 of the Grade Crossing Law, the Commission is without power to decide whether or not there shall be a crossing over a railroad track, but may only decide what kind of crossing shall be established; and where a city of the third class by its proper authorities decides, under its statutory power to lay out and establish highways, that a grade crossing should be established, it being found impracticable to establish an overhead or undercrossing, it is the duty of the Commission to permit the establishment of the crossing, if the action of the city council is not arbitrary or capricious.

NEWS OF THE SOCIETIES

May 23-28—NEW JERSEY STATE BUILDING TRADES COUNCIL. Atlantic City, N. J.

May 23-26 — AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Spring meeting. Congress Hotel, Chicago.

May 25-6—NATIONAL INDUSTRIAL TRAFFIC LEAGUE. Cleveland, O.

May 27—AMERICAN SOCIETY OF SAFETY ENGINEERS. Engineering Societies Building, New York City.

May 31-June 3—NATIONAL ELECTRIC LIGHT ASSOCIATION. Pasadena, Cal.

June 2-4—GOVERNMENTAL RESEARCH CONFERENCE. Philadelphia, Pa. Secretary, Dr. L. D. Upson, 542 Griswold st. Detroit, Mich.

June 5-10—TRI-STATE WATER AND LIGHT ASSOCIATION. Asheville, N. C. Secretary, W. F. Seitzlitz, Columbia, S. C.

June 6-10—AMERICAN WATER WORKS ASSOCIATION. Annual convention. Hollenden Hotel, Cleveland. Secretary, J. M. Diven, 153 W. 71st st., New York City.

June 13-14—CLEVELAND SECTION AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Regional meeting. Great Lakes Territory. Hotel Statler.

June 14-16—NATIONAL FIRE PROTECTION ASSOCIATION. Annual meeting. San Francisco.

June 15-17—LEAGUE OF MICHIGAN MUNICIPALITIES. Annual Convention. Kalamazoo, Mich.

June 17—PHILADELPHIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Outing at Howard McCall Field.

June 17—INLAND EMPIRE SECTION AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with engineering societies of Spokane.

June 20-24—AMERICAN SOCIETY FOR TESTING MATERIALS. Annual meeting. Asbury Park, N. J.

June 28 — ATLANTA SECTION AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Election of officers. Georgia School of Technology, Atlanta.

Sept. 28 (10 days)—NEW YORK ELECTRICAL EXPOSITION. Seventy-first Regiment Armory, New York City.

Oct. 11-14—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual Convention, Atlanta, Ga. Hotel Ansley. Secretary, James J. Mulcahey, Municipal Building, Denver, Colo.

Oct. 24-28—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Southern Hotel, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Nov. 14-18—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

BROOKLYN ENGINEERS' CLUB

At the regular meeting, May 5, the paper of the evening on the "Erection of Long-Span Bridges," illustrated with numerous stereoptican slides was presented by Frank W. Skinner, who described the three principal types of erection, one or the other of which is used for all very long spans, namely, cantilever erection, suspended erection, and arch erection, which is virtually a modification of cantilever erection. A notable illustration of the three types of famous long spans co-existent in the Niagara Gorge was shown with the railroad arch bridge in process of construction on the site of the old railroad suspension bridge still in service and the cantilever bridge in the background.

The erection of the Quebec bridge spans, successfully completed after two great disasters, was described and illustrated with pictures of the anchor arm, cantilever erection and the building, floating and hoisting of the 600-foot center suspended span. The methods employed in the erection of the Washington Plate Girder Arch Bridge, a 510-foot span across the Harlem river, that was assembled on massive falsework, and of the erection with back stays of the 1,000-foot 4-track Hellgate arch bridge and of the 1,400-foot span 6-track Manhattan Suspension bridge from a temporary suspended cable platform were described and illustrated. The paper reviewed some of the greatest achievements in bridge engineering in which American engineers hold world supremacy, and emphasized the importance of the civil engineer in all of the great interests of finance, commerce, industry, transportation and manufacture, showed how engineering construction is coordinated with world safety and progress, and particularly indicated the worthy part played in it by many members of this club. At the May 12 meeting, Paper No. 175 entitled "City Surveying—for the surveyor and the examiner of land titles," was presented by Edwin P. Clark.

AMERICAN WATER WORKS ASSOCIATION

The program published May 14 on page 418 for the annual convention at Cleveland, June 6-10, has been considerably enlarged. A new feature to which particular attention is asked, is the informal meetings in small groups which will be arranged under the following heads or topics: 1. Office Methods, Records, Accounts, etc. 2. Pumping Station, Engines, Boilers, Firing, etc. 3. Filter Operation and Care. 4. Pipe Laying, Methods, Records, etc. 5. Services and Meters, Material, laying and setting, who does the work, who pays for, etc. 6. Water Sheds and Reservoirs, Their Care, Algae Treatment, Tree Planting, etc. 7. Private Fire Protection Services.

Members interested in any of the above topics will register at the Convention Office for assignment to the desired group.

The following additional papers are announced: "A Reservoir vs. Additional Pumping Equipment for Supplying Peak Demands," L. A. Quayle. *"Cleveland's Water System in Story and Picture," G. E. Flower. *"A Sanitary Survey of Lake Erie Opposite Cleveland with Reference to the Location of New Water Works Intakes," J. W. Ellms. *"Investigation for Causes of Obnoxious Tastes and Odors Sometimes Occurring in the Cleveland Water Supply," J. W. Ellms and W. C. Lawrence. "The Rate of Solution of Sulphate of Alumina, with Reference to the Design of Solution Tanks," J. W. Ellms and A. G. Levy. "Division Pumping Station, a Description of the Station and Its Operation," J. N. H. Christman. "Fairmont Municipal Heating Plant, a Description of the Largest Municipal Heating Plant and its Operation." H. W. Kaiser. "Baldwin Pumping Station and Heating Plant and Analysis of Certain Problems Involved in the Design of This New Pumping Station and Municipal Heating Plant," L. A. Quayle. "Overcoming Difficulties with Animalcules at the Dallas Filters," Helman Rosenthal. "The Education and Training of Water Plant Operators," Lewis O. Bernhagen. "Licensing Filter Plant Operators in New Jersey," Charles H. Capen, Jr. "A Method of Determining by a Single Flow Test of a Meter Its Capacity at All Pressure Losses," Fred B. Nelson. "Water Works Publicity," Scotland G. Highland. "Construction and Maintenance of a 6-inch Galvanized Wrought Iron Submarine Pipe Line," James W. Graham.

Chemical and Bacteriological Section, June 9, forenoon: "Coagulation and Sedimentation with Chemicals," J. W. Ellms. "Some Notes on Colloidal Chemistry as Applied to Water Filtration," Milton F. Stein. *"Application of Colloid Chemistry to the study of Filtration," Malcolm Pirnie. "Turbidimetry of Water," P. V. Wells, Associate Physicist, Bureau of Standards. "The Physical Chemistry of Iron Removal from Water," Robert Spurr Weston.

Afternoon, "Application of Colloid Chemistry to the Filter-Pressing of Sewage Sludge," John Arthur Wilson, Wm. R. Copeland and Henry Mills Heisig (Milwaukee, Wis., Sewage Commissioners). "Colloid Chemistry of Tank Treatment of Sewage," Langdon Pearse and F. W. Mohlman. "The Physical Chemistry of Chlorination of Water," George L. Clark. "The Reaction of Culture Media," George C. Bunker.

*Illustrated with lantern slides.

TWIN CITY CHAPTER, AMERICAN ASSOCIATION OF ENGINEERS

At a recent meeting of the Twin City Chapter of the A. A. E., the following officers were elected: President, Frederick Paul; first vice-president, S. E. Ganser; second vice-president, L. W. Chandler; third vice-president, Ernest Marshall; and fourth vice-president, A. E. Clearman. Walter H. Wheeler, consulting engineer of Minneapolis, addressed the meeting.

NATIONAL HIGHWAY TRAFFIC ASSOCIATION

The 1921 convention was held at Detroit April 29. Reports were received from committees on Regulation of Overloading of Motor Trucks; Traffic Center Lines on Roadways; Equitable Distribution of the Cost of Construction and Maintenance of State Highways; Status of the Construction of Highway Curves and Recommended Practice to Increase Safety to Traffic; Widths of Roadways and Sidewalks in Municipalities; Motor Bus Service for Consolidated Rural Schools; Highway Transport Clearing Houses; Highway Transport Franchises; Inter-relationship of Highway, Railway and Waterway Transport; Relative Efficiency of Different Types of Car Stop Safety Zones and Their Relation to Parking and Ranking Regulations; Segregated Traffic Streets in Municipalities; and on Regulations Covering Speeds, Weights and Dimensions of Motor Trucks and Trailers.

The officers for 1920-1921 are: President, Arthur H. Blanchard; vice-Presidents, David Beecroft, R. C. Hargreaves, L. A. Nares, Jack F. Witt; secretary, Elmer Thompson; treasurer, George H. Pride. Directors, W. T. Beatty, Roy D. Chapin, J. H. Collins, R. J Corbitt, Charles Henry Davis, J. D. Eggleston, William P. Eno, John Fields, T. D. Guthrie, R. E. Hines, Thomas B. King, P. A. Koehring, Samuel P. Leeds, Irving W. Patterson, T. Coleman du Pont, F. A. Seiberling, Tom Snyder, William C. Spear, Samuel W. Taylor, J. DeMont Thompson, F. W. A. Vesper, George F. Wolz. Executive committee, Arthur H. Blanchard, R. C. Hargreaves, George H. Pride, Tom Snyder, Elmer Thompson.

AMERICAN ASSOCIATION OF ENGINEERS

At the meeting at Buffalo, May 9-11, H. O. Garman was elected president of the American Association of Engineers. The other officers elected by the association are A. N. Johnson, vice-president; A. S. Morris, second vice-president; E. F. Ayres, Webster L. Benham, Garrison Babcock, Morris Bien, G. M. Butler and W. R. McKeen were elected directors.

The American Association of Engineers has 25.000 members and the convention at Buffalo was unusually well attended. Among the important things discussed were the utilization of technical knowledge in public service, and the adequate distribution of engineering ability throughout the country, leading to better utilization of engineering knowledge.

The association is devoting special attention to helping young engineers in difficult years when they are becoming established. In the work of the organization it is emphasized that the pay of engineers should be commensurate with their duties and responsibilities; and every engineer should recognize the duties and privileges of citizenship.

An adequate preparedness program was discussed, also the observation in the engineering profession of traditional rules of conduct. In the enonomic structure of the nation the engineering profession is held by the association to be the intermediary between labor and capital.

ENGINEERING DINNER TO HOOVER

Following the meeting of the executive board of the American Engineering Council of the Federated American Engineering Societies in Philadelphia, April 16, there was a well-attended dinner at the Bellevue-Stratford Hotel. The principal speaker was Secretary of Commerce Herbert C. Hoover, president of the Federation.

The dinner was given by the Engineers' Club of Philadelphia and its fourteen affiliated societies with a membership of more than 4,600 in Philadelphia and Eastern Pennsylvania. The presiding officer was Guilliaem Aertsen, of the Midvale Steel & Ordnance Co. and president of the Engineers' Club of Philadelphia. The toastmaster was Major Joseph A. Steinmetz, past president of the Engineers' Club and chairman of the Aeronautical Section of the American Society of Mechanical Engineers. Mr. Aertsen, as president of the club, presented to Mr. Hoover a certificate of honorary membership in the Engineers Club of Philadelphia. Following presentation Mr. Hoover delivered his address.

The other speakers were Dean Dexter S. Kimball, of Cornell University, vice-president of the F. A. E. S., who discussed "The Federated American Engineering Societies"; J. C. Trautwine, Jr., editor of *Trautwine's Handbook*, whose topic was "The Engineers of Philadelphia," and George Wharton Pepper, lawyer and publicist.

The meeting of the executive board of the F. A. E. S. considered several matters of great importance, particularly the assay of waste which is being conducted by the committee on elimination of waste in industry.

ROADS CONVENTION

The annual meeting of the United States Good Roads Association, the Bankhead National Highway Association and the United States Good Roads show took place in Greensboro on April 18-23. The most important event of the meeting was the resolution adopted to urge Congress to make an annual appropriation of $100,000,000 for the next five years to aid the states in building good roads, also to adopt a system of national highways throughout the United States.

The chief addresses of the meetings were the following: "Our Nation's Road Problem," by Thomas H. McDonald; "State System vs. County System of Hard Roads," by J. H. Scarborough; an address by United States Senator Lee S. Overman; "Road Building in the Southwest," by E. P. Toney; "Origin and Historical Development of Rock Asphalt," by W. F. Pollard; "Steel Forms for Good Roads," by Edward M. Ornitz; "Practical Road Building," by Frank N. Page, John Craft, Col. W. F. Whitemore, Boggs, Sid Smith, R. C. Morefield, S. W. Fallis and G. W. Coleman; and "Types of Roads," by C. M. Upham.

MONTANA SOCIETY OF ENGINEERS

The Montana Society of Engineers at its 34th annual convention on April 9 elected the following officers: President, George T. McGee; first vice-president, Chauncy L. Berrien; second vice-president, Leon D. Conkling; secretary and librarian, Earle B. Young; and treasurer, Harry H. Cochrane.

BUFFALO, N. Y., SECTION, AMERICAN SOCIETY OF CIVIL ENGINEERS

The Buffalo section, A. S. C. E., at its first annual meeting on April 5 elected the following officers: President, A. L. Johnson; vice-president. G. B. Bassett; and secretary-treasurer, B. L. Cushing.

INDUSTRIAL NOTES

LUMBER INSPECTION RULES

4¾ x 5⅝ inches, 340 pages, illustrated, flexible covers, rounded edges, price $3, Larson & Crouch, 280 Madison Ave., New York City. This attractive book is designed to fit in the outside coat pocket for greatest convenience for ready reference use. It is an encyclopedic compendium of data furnished by the principal lumber companies and representatives of standard lumber and timber interests in the United States. It is believed to be the first publication covering description, definition and lists of different lumber products with sizes, details of qualities, requirements, defects and rules for inspection and classification covering all or almost all of the commercial features of lumber and timber business. It will be found authoritative and convenient for the use of architects, engineers, contractors and designers writing specifications and making designs and bills of material.

The specifications of many important lumber dealers and associations are given in full for about 30 different species of timber and many more varieties. It contains general rules, classifications into the principal headings of flooring, boards, planks, dimension, stepping and rough edge, and is succeeded by many other specifications enlarging the list of classifications and including poles, shingles, mining timber, railroad ties, ship-lap and specials.

These are tables of official standard weights of hard wood lumber for different thickness per thousand feet, half tones showing characteristics of different kinds of timber, specific gravities, relative hardness, commercial sizes and lengths, tests for bending, compression and shear for green and seasoned timber.

General directions for grading timber, specific descriptions of defects and codes and terms are given. Under the heading "Patterns" there are 50 pages of dimensioned diagrams, showing the cross-sections of milled lumber.

TIMBER HIGHWAY BRIDGES

Standard specifications for Southern yellow pine bridge and trestle timber as adopted by the American Society for testing materials are published in a small pamphlet by the Southern Pine Association, Interstate Bank building, New Orleans, who will mail copies on request. By C. W. Caul, 79 pages, 6 x 9 inches, illustrated, paper covered, published by Engineering Bureau, Natural Lumber Association, Lumber Exchange, Chicago, price 15 cents.

This book has been prepared through the co-operation of state highway engineers and others and contains 8 chapters, including one on types of bridges, floors and wearing surfaces, joint and metal details, plans of timber highway bridges, and data regarding quality, preservation, and a bibliography. It has 26 illustrations, most of them full-page line cuts, showing general plans and details of long and short span trusses, substructures, floors, bracing trestle viaducts, and standard spans from 20 to 170 feet long. There are bills of materials for short span bridges.

COST OF HANDLING CONCRETE PAVING MATERIALS

A handsomely illustrated pamphlet issued by Barber-Greene Co., Aurora, Ill., on the cost data of Barber-Greene method of handling concrete paving materials, tabulations of classified cost of labor and supplies for executing six paving jobs where the contractors used Barber-Greene self-feeding loaders. These records indicate savings of $23 to $53 per day and are accompanied by diagrams of the plans and operations.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

DAKE ENGINES

Catalog 28 of the Dake Engine Co. illustrates standard engines, steam or air operated, for hoisting, swinging and miscellaneous power operations suitable for construction work and other purposes, operating with equal efficiency in any position, horizontal, vertical or inclined, giving them a wide range of adaptability and making them suitable for many styles of applications where no other engine can be used. The Dake is a double reciprocative engine with inner and outer pistons arranged to completely avoid a dead center, and in reversing to make the power as nearly equal as possible in both directions. It is practical to install this engine with reversing throttle removed and connected by air hose or pipe to allow distant control.

The engine occupies less space than any other type of equal power; is strong, durable and easy to install; starts instantly, does not require constant attention; does not endanger the safety of the plant or operator; and requires a minimum of upkeep, attention and maintenance per unit of power.

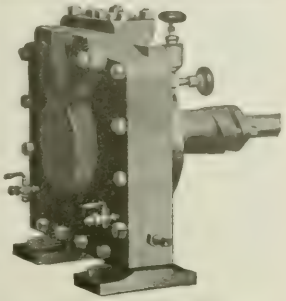
The different types described include air and steam engines, belt driven hoists, blowers, capstans, centrifugal pumps, chain hoists, single and double drum hoists, elevator hoists, crabs and winches, hoisting engines, pneumatic hoists, spud hoists, swinging gears, stationary engines, trolley hoists and a considerable variety of engines for special purposes, particularly in marine service.

The long and favorably known Dake swinging engine, which has been installed on a great number of construction jobs to operate derrick booms regardless of the type of hoisting engine used with them, is made in two types, one of which has a single lever for moving both engine and brake allowing quick and accurate dropping of the load and removing all stress or strain on gears when coasting the load. The other types of swinging engines are made in four sizes with horsepowers of 5, 10 and 15, speed of about 30 feet per minute, and with loads up to 3,000 pounds.

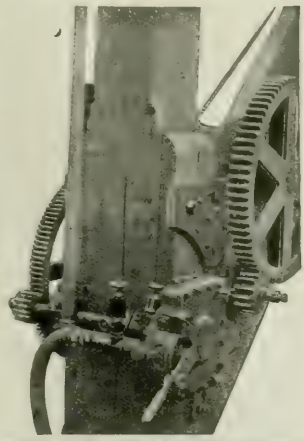
The adaptability of the Dake motor is illustrated by its use on the mast of a crane to convert it from a hand operated to a power operated tool. This is effected simply by removing the hand cranks and attaching the motor without changing the gearing.

The standard non-reversing type of air or steam motor is adapted for attachment to almost any machine or appliance not requiring reverse motion. It is made in ten sizes, being as small as ½ h. p. and up to 30 h. p. and weighs from 65 to 2,000 pounds. Corresponding reversing type weighs from 75 to 2,200 pounds.

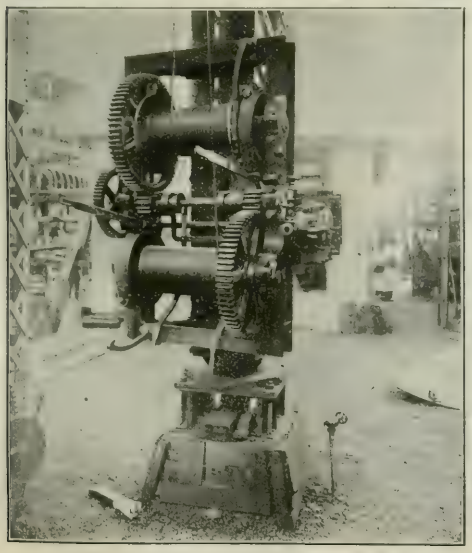
The single and double drum motor crabs for use on derricks and cranes are constructed with a rigid iron frame bolted to the mast and are fitted for use with steam or air. They are also constructed with pulley for belt drive. They are made in four sizes of 3, 5, 7 and 10 h. p., capacity varying from 1,000 pounds at a speed of



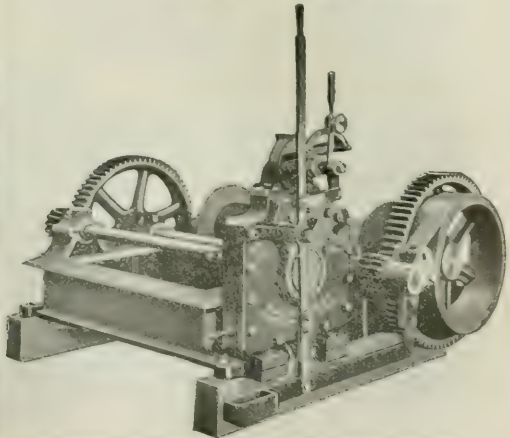
DAKE STANDARD MOTOR



MOTOR MOUNTED ON DERRICK MAST



DOUBLE DRUM REVERSING MOTOR CRAB



IMPROVED SWINGING ENGINE WITH BRAKE FLANGE ON DRUM GEAR

73, to 6,500 pounds at a speed of 38 feet per minute on a single line.

Hoisting engines are entirely without vibration and are built with single drum reversing and non-reversing single and double geared friction, double geared and belt driven hoists. Most of them are built in 5, 7, 10, 15, 20 and 30 h. p. sizes.

Elevator hoists operated by steam, compressed air or electricity are made with capacities of 2,500, 5,000 and 10,000 pounds at speeds of 50, 60 and 70 feet per minute for steam and are of 7, 15 and 20 h. p., speeds of 65 and 55 feet and loads of 1,500 and 2,250 pounds for electric power.

Electric crabs are made with single or double friction or clutch drums as required. They are bolted directly to the mast of the derrick and may be provided with a swinging attachment, having a vertical shaft that carries an inside pinion engaging the circular rack, by which the derrick is revolved.

SERVICISED JOINTS

The circular issued by the Servicised Co. describes several kinds of joints for pavements and concrete construction that are claimed to make better jobs than poured joints, cost less to install; save time, labor, material, inspection, and superintendence; insure uniformity; do not melt in hot weather; retain their elasticity in cold weather; absorb expansion, longitudinal and transverse stresses, and prevent rapid destruction of the pavement adjoining car tracks by absorbing the vibration of the rails.

The feather joint, type A (patent pending) is a light expansion joint constructed of a special waterproof and acid proof fibrous material which has a uniform or wedge shape section, will not ooze under compression, and is improved by traffic. It is made in all sizes from ½ inch in depth up to 12 inches. It weighs from 20 to 318 pounds for 100-foot lengths with cross sections of 3 x ¼ to 12 x 1½ inches.

The asphalt joint, type B, is adapted for paving and construction purposes where it is desired to keep the flow point in warm weather at a minimum and contains minute fibres and air cells evenly distributed throughout the entire mass so as to produce an elastic expansion cushion that does not liquefy or become brittle and has a strong tendency to retain its pre-moulded form.

Joint C for sidewalk work, inner curb work and other structures where the minimum is required for expansion and contraction is made in light and heavy styles, the former being from 1/32 to ⅛ inch in thickness and any width up to 12 inches. The heavy style is ⅛ inch thick and upwards and can be used in multiple strips, all of them furnished in 100-foot rolls.

MAXIMUM DEMAND WATER CONTROLLER

Some water supply systems are required to furnish an adequate minimum pressure for fire protection. If they also have one or more large consumers, whose demands are so great as to equal nearly the pipe line capacity, the pressure available for other purposes may be reduced seriously, although the pipe line can furnish the full amount needed by the large consumer without affecting the minimum pressures if the large quantity of water be delivered at a reasonable rate. For this purpose, a maximum demand or rate of flow controller, made by the Simplex Valve & Meter Company, has been developed that prevents the drop in pressure due to excessive peak demands on the water supply line.

The maximum demand controller remains open at the predetermined setting until the rate of flow reaches the prescribed maximum. From this point on, the opening of the controller is just sufficient to permit the specified rate of flow, and no more, to take place.

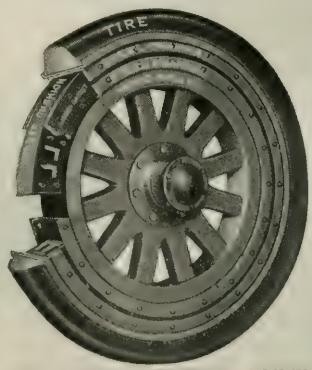
The maximum demand controller consists of a Venturi tube with a double-disk-type balanced valve. The valve stem is guided in the upper and lower covers, engages a diaphragm near the bottom of the valve body and at the top is attached through a flexible connection to the short arm of a lever or scale beam.

For any given rate of flow, there exists a certain difference between the water pressure in the valve body and that in the throat of the Venturi tube, due to the difference between velocities at these points. The downward pressure on top of the diaphragm is greater than the upward pressure below, and for this reason there is transmitted to the short arm of the scale beam a downward pull that is balanced by the counterweight on the longer arm of the scale beam. This balance of the counterweight and diaphragm loads limits the maximum rate of discharge through the controller.

Altering the position of the counterweight on the longer beam arm changes the maximum permissible rate of flow.

MORAND TRUCK WHEELS

Truck wheels made by the Morand Cushion Wheel Company have been adopted for all kinds of trucks by the owners of fleets of trucks and their methods and testimonials show that their use increases tire mileage and the life of the truck, and reduces maintenance charges. One owner states that on a Ford truck the cost of repairs for six months previous to application of the Morand wheels was $442.91. For six months after the application of the Morand wheels the corresponding maintenance cost was $143.98. The tire mileage was increased from 14,000 to 19,000 miles, the average load being 10,000 pounds.



SOLID TIRE CUSHIONED TRUCK WHEEL FOR ALL SERVICE

CONKEY CARS

Loose leaf circulars issued by E. E. Conkey & Company, illustrate design and specification of various types of small steel cars including scoop dump-cars for all standard purposes such as hauling sand, gravel, coal, concrete, with a turn-table body dumping on either side or end, and capacities of 12 to 27 cubic feet; platform cars up to 12 feet long and 6 feet wide with steel frames and steel or wooden floors that are suitable for all purposes and especially for transporting steel or wooden concrete batch boxes. The gable bottom cars dumping on either side are of 1, 1½ or 2-cubic yard capacity and are suitable for quarry and general contract work. Rocker dump cars are of 1 to 3-yard capacity, are suitable for hauling gravel, broken stone, concrete and other materials and can dump on both sides, discharging clear of the tracks. End dump cars are of 12 to 27 feet capacity and are especially adapted for use in tunnels where they require a minimum side clearance and ability to travel around sharp curves.

TRAILMOBILES AND SEMI-TRAILMOBILES

Trailmobiles are manufactured by the Trailmobile Co. in various styles and sizes adopted to hauling of all kinds of freight. The Model B, of 1,250 pounds capacity, has wooden wheels and is intended for general service behind a passenger car or light truck. Model C, of one ton capacity, is of similar design. Model K, of two tons capacity, is rubber tired and has a heavy chassis. Model L of 3½ tons capacity can be built with a box body, flat platform, rack, or with a dump body, desirable for general use.

MOTOR TRUCK ODIES

The catalog of the Auto-truck Steel Body Co. illustrates standard types and sizes of steel truck bodies and hoists and invites requests for the design and construction of any special bodies that may be required. It illustrates various types of standard steel bodies with round and square corners, with single and double tail gates, with doors and chutes, with asbestos lining for carrying hot asphalt. It lists various types of wooden box rack, stake, platform, and other types of bodies and shows the details of the Junkin horizontal hydraulic hoist, of a vertical hoist, and also of a hand hoist for dumping.

MECHANICAL SNOW LOADING

The Barber-Green loader was in continuous service in New York City for nearly a week last February in loading on trucks snow that had previously been piled in the street in long banks ready for removal. According to the records, it replaced ten men and saved the use of a third of the trucks otherwise required besides cutting down the loading time. In one hour it loaded 28 2-ton Mack trucks and on one occasion loaded a large truck in 58 seconds. In one day it cleared the snow from twenty blocks on Fifth avenue.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"

Published Weekly by Municipal Journal and Engineer, Inc.

Publication Office Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.

Entered as Second-Class matter at the Post Office at Floral Park, N. Y. August 27, 1920, under the Act of March 3, 1879.

Vol. 50 MAY 28, 1921 No. 22

Heavy Work on a New Jersey Road

Grading a mile of zig-zag highway from the Hudson river at Fort Lee to the top of the cliff, 210 feet above, at a cost of $500,000; 115,000 yards of rock excavation in side-hill cuts up to 110 feet deep. High retaining walls built with three cableways.

Section 1-A of Route 10 of the New Jersey State Highway System extends from the Fort Lee terminal of the 130th Street ferry, New York, to Arcadian way, rising about 210 feet to the top of the rocky bluff and having a length of about 6,000 feet. It was designed and the construction supervised by the State Highway Commissioners, T. J. Wasser, state highway engineer. In 1919 the contract was started by Porter & DeWitt, of Edgewater, N. J., who have prosecuted the work under difficult conditions and have brought it to completion by vigorous and efficient efforts and the installation of a large amount of labor saving plant and equipment.

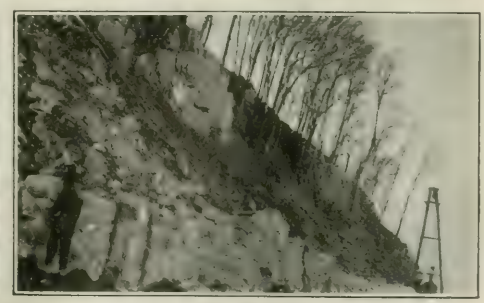
The contract price of about $500,000 included grading, draining and the construction of retaining walls and parapets, but did not include the road surfacing.

LOCATION AND DESIGN

The road zig-zags up the face of the steep cliff in two long and approximately parallel inclines with maximum grade of 6½ per cent and curves of about 1,000 feet radius. The inclines are connected by 180-degree curves, which are 150 feet across transversely, and widened to 74 feet with a horizontal section between the two inclines. These curves are located chiefly on a heavy rock fill about 400 feet long on top and 50 feet high, which contains about 40,000 yards of rock wasted from the excavation. The most of the remainder of the rock excavated was dumped alongside the cuts building up, in some places, the outer edge of the roadway of the lower incline. At the top of the upper incline the road has another short bend of about 180 degrees, and grade of about 2 per cent. About 600 feet farther on it bends about 90 degrees, connecting with an existing road on the top of the hill.

The graded width of the road is 44 feet and the paved width will be 34 feet plus one 8-foot sidewalk. The road is built chiefly in terrace excavated in rock cuts up to 110 feet high on one side, and for 75 per cent of the length of the section, with retaining walls on the opposite side up to 50 feet high, in trenches up to 15 feet deep. Retaining walls 3 feet thick at the top and battered 2 inches per foot, are made of large pieces of rubble rock obtained from the cuts, sometimes laid up dry, and sometimes with cement mortar, and are all provided with abundance of weep holes to drain the water from the loose rock fill on the highway side. These retaining walls contain

CENTRAL PORTION OF SHOVEL CUT ON NORTH LOOP



DRY WALL ON UPPER LEVEL

FILL ON NORTH LOOP

about 16,500 cubic yards of masonry at a unit price of $3.86 per yard. There were 14,000 yards of earth excavation at $1.45 and about 114,000 yards of rock excavation at $3.39.

The rock is a very rough, tough trap formation with irregular seams and much of it badly weathered so that considerable dressing was necessary to remove loose or threatening fragments that might fall onto the road. The numerous vertical seams permitted it to be blasted on very steep slopes, sometimes almost perpendicular, that made for a minimum amount of excavation on the upper side of the road while on the lower side irregularities and steep pockets often made it necessary to excavate to a considerable depth for the footings of the retaining walls.

The slope was so steep, and the surface so rough, that considerable difficulty was encountered in delivering and distributing equipment and plant at the intermediate points of the road, beside which the road was accessible only from the lower end, thus involving an estimated increase of 25 per cent to 30 per cent over the cost of construction had the road been accessible from both ends. In many places the character of the cliff was such that men making the reconnaissance surveys and preliminary drilling and blasting had to be suspended by ropes and work with safety lines and belts.

STEAM SHOVEL WORK

Work was commenced at the upper end of the road at the rectangular intersection with an existing highway where the grades begin with was light and the surface of the ground fairly regular. Three steam shovels were installed and gangs of men with picks, shovels and steam drills operated with compressed air furnished by compressors mounted on the steam shovels, served the shovels that handled the earth, rock and boulders, spoiling them alongside the right of way, delivering to about 40 double-truck 3-yard dump cars hauled by four 12-ton Baldwin and Davenport locomotives on a 24-inch gauge service track laid with 40-pound rails and continued for about a mile along the full length of the road, which was laid as the grading advanced.

As the work progressed the alignment curved to a tangent nearly parallel with the base of the bluff, which it began to ascend on a 5½ per cent grade terraced on the very steep and jagged surface, which was composed of 90 per cent rock with a few trees and shrubs. Most of the rock projections had to be shattered by blasting before they could be detached by the steam shovels. The excavation proper was a cut with a horizontal bottom 20 to 50 feet in width with very steep face sometimes almost perpendicular, on the side toward the hill.

In some cases the spoil was dumped directly alongside the cut, building up a fill on the outer side that widened the grade and diminished the amount of excavation when the topography was such as to provide a suitable bottom for the embankment. At other times the topography was such that it was necessary to make the cut somewhat wider than the required 44 feet in order to trim away all of the loose rock on the hillside, and leave the exposed surface sound and safe.

LOOKING TOWARD LOOP, SHOWING RETAINING WALLS AND SLOPE WALL

RETAINING WALLS

Generally it was necessary to secure the outer side of the roadway by a retaining wall with foundations carried down somewhat below the original surface of the ground to be beyond frost action, and to secure sound rock for bearing. The trench thus excavated varied in width from about 6 to 24 feet, according to the depths, which were from 15 to 55 feet.

Some of the wall was regular retaining wall laid dry with gravity section to resist the pressure of loose stone and earth fill behind it, and some, where the rock, exposed in the hillside was very steep and irregular, was built as a masonry veneer to protect it and provide for the continuity of the wall. In some of these cases the veneer was so nearly vertical that the stones were secured to the face of the rock by 1-inch steel dowels 3 feet long placed 2 feet apart on centers made with split and wedged ends, grouted into the drill holes.

The top of the wall was surmounted by a rub-

ble masonry parapet laid with cement mortar and capped with narrow transverse, horizontal stones 2 or 3 inches apart in the clear, having sharp upper corners presenting a rustic appearance and discouraging the use of the wall as a promenade or seat.

UNDERCUTTING THE FACE OF THE BLUFF

The depth of the cut varied from about 25 feet to 110 feet and it was made entirely by undercutting without the use of any vertical drill holes. A lot of the drilling was done by five large size Ingersoll-Rand jackhammer drills and five Ingersoll-Rand 3¼-inch tripod drills, the latter being operated by compressed air from the power plant established at the lower end of the road, delivered eventually by a 2-inch pipe line extending nearly to the top of the cliff. Holes 15 to 20 feet long were drilled as close to the bottom as possible and were inclined downward from the horizontal about 1 inch in 3 inches. They were sprung, sometimes several times, and finally loaded with 40 per cent and 60 per cent dynamite, which was fired by electricity. On account of the toughness of the rock, its treacherous character, and its irregular seams, the drilling and blasting was very difficult and it sometimes took as much as five days to drill, load and fire a set of four holes which would usually break from 500 to 1,000 yards of rock when shot. The character of the rock made the drills dull very rapidly and made the holes cost up to $1.75 per linear foot.

Because the face of the hill was so high and steep, and because dwellings were built close to the foot of the hill, great precautions were taken in blasting and the charges were covered with rope mattresses and chained logs to reduce danger from the flying stones. Nevertheless, many large stones rolled down the steep incline and landed on private property, but none of them did much damage and no serious accident occurred during the execution of the work. If it had not been for the necessity of safeguarding the nearby residents, the contractor would have followed the alternative plan that he considered, of tunneling under the foot of the slope, making short side drifts, loading them with heavy charges of explosives, and firing them simultaneously so as to bring down vast quantities of rock with a single shot.

ROCK VENEERED WALL, LOWER LEVEL
Face of wall is backed up with concrete, with surface joints left open to imitate dry rubble.

CABLEWAYS

The blasted rock was handled almost entirely by the shovels and by three Lidgerwood cableways of 400 feet span that were installed at successive points over the alignment of the retaining wall to place the stones used in the wall. The stones were of large size, up to 8 tons, and were swung several feet transversely and hauled longitudinally by the trolley hoist of the cableway that was high enough to allow the load to be fleeted fifteen or twenty feet when necessary.

The cableways were shifted forward as required by lowering the 40-foot wooden transverse bents that formed the towers and dragging them forward on the ground by the hoisting engine operating a tackle anchored in advance, after which the tower was easily revolved again to vertical position, guyed and the cableway restored to service after an interruption of about three days, always arranged to include a Sunday, and thus only interfere with two working days. Dynamite was purchased in carload lots and stored in a standard magazine about a mile from the work, from which it was delivered in small quantities daily.

PROHIBITIVE COST OF ROCK CRUSHING

The contractor established a plant with a 15 x 24-inch and a 10 x 28-inch Farrell stone crusher, and a storage bin, engine, boiler, etc., complete, costing about $14,000. With it he crushed about 3,000 yards of stone for the concrete pavement, but the work was made difficult and expensive by the extremely high price of coal, which cost $17 per ton delivered to the crusher, labor was so scarce, costly and inefficient, and the difficulty of transporting stone to the crusher without interfering with the steam shovel service, combined with the intermittent supply, the lack of storage for rock at the crusher and cost of rehandling it, made the cost of crushing the stone as great or greater than that of stone purchased in the open market, although the quality of the trap rock was excellent for concrete or macadam stone. Eventually the contractor sold the stone that was already broken, that was not required at present for the road surface or for local concreting and dismantled the crushing plant.

Besides the plant already mentioned, the contractor installed an Ingersoll-Rand air compressor with a capacity of 850 cubic feet of free air per minute to a pressure of 100 pounds, 6,000 feet of 2-inch air line pipe, 6,000 feet of 1½-inch city pressure water pipe, an 80 h. p. boiler and a Leyner drill sharpener. The maximum force employed was 125 men, the average force about 50, and the average pay, including the laborers, foremen and overtime was $7.75 per day. On May 1 the work was about 95 per cent completed, and it is expected that it will be finished, ready for laying the road surface, within a few weeks. It has not yet been decided what surface will be built, but it is probable that it will be paved with temporary bituminous penetration macadam and after a year or two, when the fill has thoroughly settled, the macadam will be used for a foundation for a hard surface.

New Orleans Inner Harbor

A few weeks ago the city of New Orleans dedicated a harbor and canal which is connected with but not a part of the Mississippi river and is large enough to receive any boats using the river. The question naturally occurs as to why the city should have spent these millions for an artificial water front and channel when it already had the river front and river outlet to the Gulf.

The answer goes back to 1795, when a Spanish treaty was made declaring the banks of the Mississippi river public property not subject to private ownership and development, which treaty was confirmed by the United States at the time of the Louisiana purchase. This made it impossible for manufacturing or commercial interests to build docks and warehouses along the water front, and thus presented a serious handicap to the development of the city's commerce. The new canal running from the river to Lake Pontchartrain will be restricted in no such way and it is proposed that all of the frontage be sold or leased to private interests to be used for docks and warehouses. It was found impossible to secure legislation that would modify these treaties, and New Orleans is confident that the money spent will prove to have been well spent.

This canal, which is now nearing completion, will be 5½ miles long, 30 feet deep below the Gulf, 150 feet wide at the bottom and 300 feet at the surface. There will be a lock at the river 1,050 feet long with 75 feet clear width. This project has been under discussion for nearly twenty years.

This development at New Orleans is only one of the scores that are taking place or are under serious contemplation in various parts of the country, for the development of rivers so as to facilitate navigation and for the construction of canals and harbors. Among the latest of the latter is the letting of contracts for development of a harbor at Wilmington, Dela., which it is estimated will cost $1,750,000 and will include a quay wall 1,400 feet long, sheds, rail connections and yards, etc.

Novel Concrete Bridge Erection

The Wichita Falls Highway bridge has reinforced Pratt truss spans 66 feet long that were pre-cast at the site and then erected as units by a method that was said to secure considerable economy by the elimination of pile falsework and delays that might have been incurred waiting for a favorable stage of the river if other methods had been adopted.

After the completion of its sub-structure a steel through span was erected on it at one end of the bridge, providing a working platform on its floor between the trusses, that was initially and temporarily loaded to produce the same deflection as that caused by the pair of finished reinforced concrete trusses. The loaded floor served as a casting floor on which the permanent trusses were concreted in horizontal position, the floor serving as the bottom of the forms, which only required short vertical side pieces to complete them, thus making much simpler and cheaper forms than would have been required for casting the truss in vertical position.

After the trusses were sufficiently hardened they were revolved to vertical position, seated permanently on their piers and abutments and the pre-cast reinforced concrete floor beams with reinforced bars projecting beyond their ends to form part of the sidewalk cantilevers subsequently concreted, were inserted through the 15 x 42-inch rectangular openings left for the purpose in the lower part of the trusses.

The weight of the steel falsework span was then transferred to rollers on the horizontal top chord of the new span, and the steel span was moved forward and served to support the next concrete span during erection, and so on, until the work was satisfactorily completed by the Jenkins Bridge & Construction Co., Denver, Colo.

Oregon Highway Testing Department

Results of more than a year's work by the State Highway Commission shows a great saving in cost and increase in efficiency of construction.

The Oregon State Highway Commission began organizing a testing department and equipping a laboratory in September, 1919, when Kenneth S. Hall was appointed testing engineer and given charge of the department. It was not possible to obtain equipment until the end of the year, but since January 1, 1920, all testing work has been done by the department.

By far the greatest volume of work of the testing department was in connection with the bituminous mixtures of the various paving plants throughout the state. The field inspection at each plant was handled by a resident inspector whose duties were to see that the operation of mixing and the grading and proportioning in the mixture were according to specifications. Daily representative samples of the mixture were sent by him to the laboratory for analysis. Considerable difficulty was encountered in securing a sufficient number of experienced or capable men for plant inspectors but with careful instruction and frequent visits of the testing engineer to the various plants in the state and of his first assistant to those plants in the vicinity of Salem, the quality of the work was excellent and practically every plant was turning out a well controlled mixture within a few days of its starting operation. Of course, in some cases the varying quality of materials caused trouble but such cases were given an extra amount of care and attention.

In addition to the supervision of the paving plants, scores of sand and gravel deposits, rock quarries, and manufactured products were investigated by this department and advice given engineers on various branches of construction

The laboratory and office were operated under the direct supervision of N. M. Finkbiner, assistant testing engineer, and employed six men during the rush months of June, July, August and September. The work in the laboratory was reduced to an efficient and, wherever possible, to a routine basis so that the greatest possible amount of work was turned out per man per day. The prime importance of service, especially in the case of daily control samples, was constantly borne in mind. Without this service the effort exerted on paving plant control in the field is half wasted. To maintain this service the two men running "hot-stuff" samples turned out as high as forty analyses in a single day and with not more than a half dozen exceptions were "hot-stuffs" allowed to remain until the day following their receipt in the laboratory. With these exceptions the reports of the analyses were in the return mail at night. During the month of July the laboratory turned out an average of 24.5 "hot-stuff" analyses per day.

Another important branch of the work of the department was that of control tests on concrete mixtures carried on in connection with the work of the Bridge Department. The purpose of this work was to adjust the mixtures to suit the conditions and quality of local concrete materials so that a maximum strength concrete can be obtained at a minimum cost, for in many cases the stereotype mixtures usually specified will not give the best results with the available materials. Concrete cylinders were cast on the work, sent to the laboratory and tested. The results then were compared with laboratory tests made and changes in mixture made if necessary. This year the concrete control work has been more or less in an experimental stage but it has shown such promise that in the coming year it will be applied to all concrete work of the state. It will necessitate the installation of some additional apparatus which will well pay for itself in service and improved quality of the work in the field. The other work of the laboratory has been the chemical and physical testing of rock, gravel, sand, cement, paints, pigments and in fact nearly all classes of materials used in highway construction.

The saving effected by the operation of a state-owned testing department has been considerable, as the accompanying table shows. The commercial rates used are in the majority of cases those paid by the state for tests prior to the taking over of the work by the testing department. The testing laboratory expense is its actual running expense plus 20 per cent of the cost of apparatus and equipment. The total installation cost was $2,923.28.

Kind of Test	No. of Tests	Commercial Rates	Total Cost
Asphaltic concrete, top	1,272	$5.00	$ 6,360.00
Asphaltic concrete, base	841	5.00	4,205.00
Asphaltic concrete, cut	285	5.00	1,425.00
Rock and gravel	254	5.00	1,270.00
Concrete sand	121	5.00	605.00
Muck sand	51	3.00	153.00
Cement	271		
	(48,208 bbls)	.03 per bbl.	1,446.24
Asphalt, complete analysis	27	5.50	148.50
Asphalt, penetration	67	1.50	100.50
Miscellaneous (G. I. pipe, paint, oil, etc.)	114	3.75	427.50
Total	3,303		$16,140.74
Total laboratory expense			7,076.27
Total saving			$ 9,064.47

The total expense of the testing department, including the field supervision and inspection and laboratory expense plus 20 per cent of installation cost, was $16,439.53. This means that we obtained all the tests, general field supervision and inspection and 20 per cent of the cost of a well-equipped laboratory for $7,076.27 more than the tests alone would have cost on the old basis. The average cost per test at commercial rates would have been $4.89. The actual average cost was $2.15.

The saving in cost, however, should not be considered as the only benefit derived from the testing department. It has rendered to the jobs in the field more efficient and speedy service than they have ever had before. It has enabled the keeping of a history of the jobs as they progressed so that investigation in the future toward the improvement of the quality of construction will be greatly facilitated. In the future the department will be of great service in passing on local material before a job is advertised for bids, thereby leaving no doubt in the contractor's mind as to what materials will be acceptable. This, in the majority of cases, will tend to lower bid prices and give the best possible job for the money.

Rustic Culvert for Park

In the construction of the Bronx parkway (described in PUBLIC WORKS for October 2, 1920) it was necessary to build a number of culverts to carry under the roadway and to the Bronx river small streams and storm drainage from the high land beyond the road. Several of these had previously been carried to the river in lines of cast iron pipe, and this pipe could have been continued in use for this purpose. It would be necessary, however, to have the upper part of the pipes exposed, which would be unsightly in a park, or else to fill in the land adjacent to the pipes in order to bury them; neither of which alternatives was considered desirable.

The solution adopted in a few cases is illustrated by the accompanying photograph. The cast iron pipe was taken up and part of it relaid in the form of a double culvert under the road, where it was out of sight. At each end of the culvert a rustic face wall was built of stone that was found on the spot, much of it formerly

CULVERT AND CHANNEL, BRONX PARKWAY

used for retaining and slope walls, and from the road culvert to the river an open channel was excavated and was lined on both bottom and sides with large stones, most of them considerably larger than one-man stone. The stones standing at a slight inclination from the vertical along the sides in the illustration are 3 or 4 feet in their longest dimensions, while those in the bottom are most of them a foot or two across. The pavement in the bottom of the open channel is laid in a succession of flat inclines and steps, to produce a pleasing agitation of the water as it flows toward the river. These stones are all too large to be moved by any amount of water likely to pass through the culvert. They are not hammered or dressed, but their surfaces were all weathered and the effect is much more in keeping with the surroundings than would be a wall laid in mortar or even laid up dry.

Gravel Roads in New Hampshire

Study of material in all parts of the state made by testing laboratory, and conclusions as to desirable characteristics.

The 1920 report, which is the 8th biennial report of the state highway department of New Hampshire, shows a continuation of the general policies previously adopted by that department, although naturally developments have been made along certain lines to meet traffic changes. An increased amount of bituminous material has been used for surface treatment, the department having contracted last year for 589,000 gallons of oil and 600,000 of tar. "The department has also used a considerable amount of calcium chloride for a dust layer. The material is considerably less expensive than oil and is quite satisfactory where only a dust layer is necessary." Much more surface treatment has been found necessary for the gravel roads both to eliminate dust and to prevent raveling under the tremendously increased traffic.

"Recently there seems to have appeared an epidemic of poor Portland cement on the market. The number of rejected lots seems to be rapidly increasing. One contractor had four carloads thrown out by the laboratory on account of its inferiority. No really important work should be started until the cement is submitted to the 7 and 28-day tests."

The department's testing laboratory has made an investigation of the gravels of the state in both field and laboratory, this having been begun in 1917, but interrupted during 1918 by the absence of the investigators on war service. Field work has reached practically all towns of the state and samples have been taken from most of them. These include bed rock, field stone, grave', till and rotten stone. Over 450 samples of gravel have been studied. The composition of each sample is found by a careful count of the number of pebbles of each rock type in at least 100 stones, and the resistance to wear has been determined by a modification of the Deval abrasion test.

The laboratory is now in a position to advise an engineer or a local road builder where to obtain the strongest material, whether rock, field stone, or gravel, in any town or district; and when samples are submitted, to judge intelligently of their value without going through the standard tests. Besides forming a basis for future discovery and judgment of materials, this survey has led to the purchasing of a number of local quarries where good road building stone had been unsuspected and of gravel banks that have more than local possibilities.

The annual report describes at considerable length the results of the investigation with valuable suggestions for locating desirable deposits and judging their fitness for use. Nine-tenths of the gravel banks now in use were located by gravel turned up in plowing, excavations for wells and cesspools, post holes for fences or telephone poles or in the preliminary grading of roads. "Even a freshly dug woodchuck hole may point the way to gravel at a place where neither road agent nor geologist would see reason to expect it." However, the locating of gravel has been made something of a science. The topographic form of a gravel deposit may be as reliable a guide to the discovery of a new bank as the showing of gravel on the surface of a freshly plowed field.

Discussing the road building qualities of New Hampshire gravels, the report states that "durability depends in the first case upon the presence of a fair amount of coarse aggregate—that is, stones between 1¼ inch and 2 inches in short diameter. Such stones will support a heavier load than smaller stones or sand. Any gravel in which sand constitutes over 30 per cent of the mixture is best regarded as unfit for use in the surface course, because it will tend to act as a soft cushion through which the stones are pressed. Durability depends directly also upon the strength of the stones that compose the mixture. Pebbles of trap, quartzite, felsite and hard crystalline schists are much more resistant to wear and much tougher than stones of slate or granulated schists or the more crumbly types of granite."

"Ability to stand up under traffic is governed to some extent by the grading of sizes in the mixture. The ideal gravel is one in which all sizes within the specified limits occur in such proportion that the voids are reduced to a minimum."

"The shape of the stones in the aggregate affects the behavior of the mass as it compacts under traffic. Angularity favors compacting, since somewhat angular stones, once wedged against one another, are likely to stay fixed instead of slipping or rotating." Flatness of stones is usually undesirable, since it affords chance for shearing at the joints between them.

The matrix of the mass ultimately consists not only of the sand and clay in the original mixture but also of dust ground or crushed from the gravel under traffic. In the long run, the more durable gravel is more economical, although it may lie

loose on the surface for a season or two before it gives entire satisfaction. Cementing by chemical action depends partly upon the solubility of the particles. Gravels rich in lime carbonate, like those on areas of calciferous schist, are quickly attacked by ground water which carries dilute acids that dissolve the lime carbonate, which is redeposited in adjoining spaces. Some of the gravels in eastern Vermont are so rich in lime carbonate that they have been deeply, though irregularly, consolidated while still in the bank. When laid on the road and packed by traffic, particularly in wet weather, these gravels set almost like Portland cement; and although the stones in them are very soft, the compacted gravel makes a road that holds up under traffic much better than some roads built of stronger material.

"The cementing of gravel by colloids is less thoroughly understood and many theoretical problems are involved. The grinding of gravel under traffic produces much impalpable powder. Some of this has peculiar adhesive properties which class it as colloidal."

The only way to judge the grading of gravel is to study it closely at the bank where as much material as possible is exposed to view. It is impracticable to secure a sample which will be even approximately representative of the grading of the entire bank. If the examination of the bank reveals the fact that parts of the deposit are too sandy or too cobbly, there is no practical solution but to have a vigilant inspector at the bank who can insist on the right material being selected or a satisfactory mixture being obtained. This is a field and not the laboratory problem.

The report states that the abrasion test has given the best-known standard for judging the durability of gravel in every case, but that the laboratory has sought to check this information by personal inspection of roads where the gravel has been used and by conference with division engineers or local road agents. The facts and opinions thus determined are kept on file for future reference in the form of loose-leaf notes.

Fire Engine Pumps Public Water Supply

At Clintonville, Wis., during a recent electrical storm the electric motors used in the city's pumping station for operating the pumps were burned out. These pumps raised water for the city's supply into a tower which is about one mile from the pumping station and 164 feet higher. In the emergency, while the pumping plant was being put back into service, a fire truck (built by the Four-Wheel Drive Auto Company) was brought to the plant, the suction hose lowered into the suction well and two lines of hose connected to the pipe lines inside the pumping station. The fire engine then pumped water from the well into the system by means of its 500-gallon engine and managed to maintain service until the regular plant was in operation.

Florida State Highways

The Florida Engineering Society was organized only about four years ago, but has 178 members and appears to be flourishing and active and is a most useful agent for securing advancement of the best interests of the profession in the state. In its latest convention, last February, a paper was read by one of the members calling attention to the condition of the state highway department and the state highways which was far from commendatory. The aim of the criticism was apparently constructive rather than destructive, however, as the author urged the society to co-operate towards securing legislation and a reorganization of the department more favorable to the proper construction and maintenance of the state highways.

The state highway department was created in 1915, but apparently little was done for or by it before the war. In 1919 it seemed desirable to change the law so as to pay four of the five members of the highway board a salary of $50 a month, and the chairman one of $4,200 a year. Apparently, however, the duties of the chairman and of the state highway engineer were not well defined, and from that time on there was conflict of authority. The state highway engineer had no authority to reorganize the engineering force or even to make the most trivial decision without the consent of the chairman. The field engineers had to refer all details of their work to the chairman. In only a few instances had the location been completed and many miles of work were cleared and

FIRE ENGINE PUMP SERVING TEMPORARILY AS WATER WORKS PUMPING PLANT

grubbed before the grade lines had been established. For several months work was carried on without a profile to show the distribution of materials.

In 1920 about 600 convicts were turned over to the department for use in road construction and were under the charge of men who had not the slightest idea of road construction, and no experienced construction superintendents were employed. Resident engineers had charge of the several districts, but when the convict captains complained about taking orders from them, the chairman of the state board issued an order that the engineers were to stake out the work but have nothing further to do with it.

The engineers were naturally disheartened and dissatisfied and letters of protest and resignation poured into the office. In an effort to improve matters, the chairman appointed the chief clerk as principal assistant engineer in charge of all office work, and his opinions have since then overruled the recommendations of the chief engineer.

"To begin with, there is practically no morale among the employees of the department. Some of the hardest knocks come from men in actual charge of the work." The principal criticisms from the employees are that there is "lack of proper adjustment of salaries paid to the different grades of field men; constant changing of headquarters of field men without regard to family and home conditions of the employees; no direct line of promotion; failure of the department to pay salaries and reimburse expense accounts promptly; delay in honoring requisitions for materials and the ignoring or delay in commenting on reports and answering letters and telegrams."

Contractors complain that it is almost impossible to secure a decision in regard to any questions arising on the work. The resident engineer passes the question up to the division engineer, who, in turn, takes it up with the chief. It then rotates on to the government engineer (if it is a Federal Aid job), then on to the chairman, after which the buck is usually passed back to the resident engineer. After about a month's delay the several engineers and the contractor may get together, when the question is settled. The contractors also resent the failure to pay estimates promptly unless the contractor makes a personal trip to Tallahassee and follows his voucher from one department to another.

These conditions have resulted in an addition to contractors' bids of 35 per cent to 50 per cent to cover cost of Tallahassee expenses, delays, incomplete plans, etc. The public also has complained because the department has promised to construct numerous roads asked for, but has carried out comparatively few of these projects.

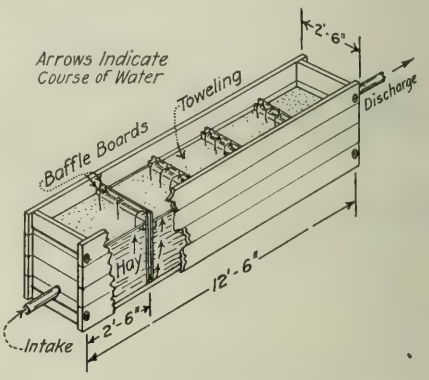
At the end of 1920 a new highway board was appointed. Whether the new board will be able to better conditions and restore confidence, the author of this paper doubted. Lack of money will prevent it from carrying out many of the promises made; in fact, in order to accomplish any real work it will have to concentrate all of its energies and finances on a few of the principal roads.

A Home-made Feed-water Filter

Muddy river water was made satisfactory for boiler use for a tug boat used for river work in the Miami Conservancy District by passing it through a simple filter made by H. A. Hanson, superintendent, and B. H. Tucker, captain of the Miami River Scow and Tug Boat Service.

The filter is contained in a long, rectangular wooden tank, divided into several compartments by double transverse, vertical partitions with a small clearance between the units of each pair, forming a narrow well through which the water passes, entering at the top and leaving at the bottom.

The partitions act as baffle boards, the spaces between which are filled, nearly to the top, with marsh hay covered with turkish toweling nailed on rectangular frames that just fit the horizontal cross sections of the compartments.



HAY FILTER FOR FEED WATER

The intake is at the bottom of the compartment at one end and the water, rising through the hay and the turkish toweling cover, overflows the first of the pair of baffle boards and enters the second compartment through an opening under the second baffleboard of the pair, rising through the hay and toweling, passing down between the next pair of baffleboards, up through the hay, down and up, and so on to the end of the filter, which may consist of as many compartments as is desired, the water finally being discharged through an outlet at the top of the last compartment.

The sediment is deposited in the hay and is strained out by the toweling and the water comes out clear at the discharge end of the filter. The deposition of silt in this filter was so rapid that the first towel screen became clogged and diminished the flow materially in two or three days, so that it was necessary to take out the screens and wash them with a hose and replace them at frequent intervals. This sufficed and the hay required no attention, except to replace it entirely at long intervals.

PUBLIC WORKS.

Published Weekly
by
Municipal Journal and Engineer, Inc.
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba....$3.00 per year
All other countries ....$4.00 per year

Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

CONTENTS

HEAVY WORK ON A NEW JERSEY STATE ROAD—Illustrated 443
New Orleans Inner Harbor 446
Novel Concrete Bridge Erection 446
OREGON HIGHWAY TESTING DEPARTMENT. 446
Rustic Culvert for Park—Illustrated 447
GRAVEL ROADS IN NEW HAMPSHIRE..... 448
Fire Engine Pumps Public Water Supply—Illustrated 449
Florida State Highways 449
A Home-Made Feed-Water Filter—Illustrated 450
EDITORIAL NOTES 451
Fantastic Bridge Work—The User Should Pay
PNEUMATIC CONCRETE MIXER FOR JAP TUNNEL—Illustrated 452
SERVING CONCRETE PAVING MIXERS FROM CENTRAL STORAGE PLANTS 454
Trackless Trolleys 455
WHAT ARE THE BEST METHODS OF HANDLING GRAVEL FROM CAR TO CONCRETE MIXER? 456
Pennsylvania Highway Work 457
PAVING MATERIALS IN VARIOUS COUNTIES 458
RECENT LEGAL DECISIONS 460

Fantastic Bridge Work

On the principle that everything which goes is a success, the Wichita Highway bridge, noted in this issue, is a success and we have no reason to doubt that it may perform long and honorable service. Its builders are certainly entitled to appreciation for the ingenious manner in which they have applied standard, although little used, methods of steel bridge erection in the construction of concrete spans which is usually executed in a radically different manner. The erection method certainly has the merit of being rational and effective and probably attained greater safety and economy than would have been secured by ordinary concrete bridge erection methods.

The fantastic element is the probably misguided attempt to imitate legitimate steel construction work with concrete which is not adapted to such purposes but is well adapted to an entirely different type of construction, which may be, and generally is, more artistic and efficient than structural steel in cases for which it is specially suitable, one of them often being for the construction of highway spans up to 100 feet in length.

Concrete should be used primarily for mass work, to resist compression stresses, and in combination with steel tension elements for beams, girders and struts, and secondarily as a protection for structural steel. In structural work no tensile service should be imposed on it, and in the highly differentiated stresses of a Pratt truss where half the members are tension members in which there can be no saving whatever of steel, no matter how well the concrete is designed, and in which there are very serious difficulties in detailing and carefully combining the tensile and compressive functions, it is more than doubtful whether a combination of steel and concrete for the principal members can be made advantageous or be justified except as concrete may be used as a purely secondary material for the protection of complete structural trusses.

This criticism does not in the least apply to reinforced concrete arches, arch-rib beams, or girders in which full advantage is taken of the mass, or to independent concrete work, which are not involved in the clumsy concrete truss construction.

It may be claimed that the depth of the trusses could be made smaller than that of concrete arch ribs, thus facilitating the erection by the methods employed but while this assertion would be subject to discussion, it cannot be denied that solid web reinforced concrete girders can be properly made of less depth than either trusses or arch-ribs. It would, however, have been quite possible to arrange for traveling falsework spans that would have supported concrete arch ribs or girders while being cast and allow them later to be revolved into position the same as the trusses were. Furthermore, it has been demonstrated that the reinforcement steel necessary for the reinforced concrete girders and even for some types of arches, is adequate, when properly treated, to form a self-supporting framework that can carry the concrete during the construction of the finished members and thus eliminate other falsework.

The User Should Pay

It is becoming more and more the opinion throughout the country that a large part of the cost of both constructing and maintaining highways should be paid by the owners of motor vehicles. Most of such owners admit the justice of assessing against them a part of such cost, but do not all agree that they should pay the largest part of it.

The question is, of course, a complicated one and the basic principles for providing highway costs have by no means been satisfactorily established. There is this to be said, however, that if the automobile had not come into existence, the amount of money spent on highways since the advent of these vehicles, in excess of the total license fees that such vehicles have paid, would have maintained the old roads for horse travel for many decades to come. Consequently, every dollar spent on highway work for the next 25 to 50 years will have been made necessary by the automobile exclusively.

Reasoning in some such way as this, the highway commissioners of Massachusetts are urging the legislature of that state to adopt House Bill No. 1629 for raising the fees paid by motor vehicles in that stateby an amount which it is estimated will add between $1,000,000 and $2,000,000 to the amounts that would otherwise be paid by automobilists for the state highways. In order to present their ideas to the public and secure a popular support for the measure, the commissioners have published and distributed a leaflet giving some facts, figures and opinions.

In the twenty-seven years since motors began using the highways, the state has spent more than $20,000,000 for construction and $10,000,000 for maintenance, and at the same time the cities and towns have spent more than $180,000,000 for the same purposes; while during this time the motor vehicle operators have contributed in fees less than $11,000,000. During the next ten years $90,000,000 must be spent on highways by the state.

The future improvement consists as much of widening as of strengthening the pavements, the former due to the vast numbers of pleasure automobiles and the latter to trucks. Therefore the fees of the light vehicle as well as those of the truck should be increased. (This point has been overlooked in many discussions of the subject.) Owing to the high cost of maintenance and the continually increasing demands of traffic for improvement in pavements the commission is right, we believe, in arguing for a pay-as-you-go policy instead of piling up bonds for the next generation to pay.

The fees of $15 to $40 proposed for pleasure vehicles and $20 to $150 for motor trucks may seem high; but they are no more than the cost of one tire or a small bill from the repair shop—sums that automobilists pay unhesitatingly several times a year, and which are more than saved them by the improvement of the highways that their fees make possible.

In Massachusetts the automobilists are opposing the increased fees, claiming that more of the road burden should be carried by general taxes, by owners of horse-drawn vehicles and by abutting property. But the bonds issued in the past and the payments already made by abutting property have been sufficient, as already stated, to have maintained the roads for the past twenty years and to continue to maintain them for a great many years to come, had the automobile not added its much more destructive use to the comparatively light wear of the horse-drawn vehicle, and the demand for a construction that costs several times as much as that which sufficed previously.

Laying 273½ Yards of Highway Concrete Per Hour

A well-organized force and well-planned equipment installed on the job enabled McCree, Moose & Co., St. Paul, to concrete 7½ miles of an 18-foot roadway in Minnesota at the rate of 1,094 linear feet, equal to 2,188 square yards of concrete, in one 8-hour shift.

The aggregate is stored at a central mixing plant located 3¾ miles from each end of the 7½-mile section of road under construction. Sand and broken stone are delivered in gondola cars. The sand was dumped to a track pit and then delivered by two belt conveyors to a 20-yard storage hopper over the mixer. The stone was unloaded by 1-yard clam-shell buckets, operated by an 85-foot derrick boom that delivered to a 25-yard hopper bottom storage bin over the mixer and after this was filled delivered the excess to a stock pile on the surface of the ground, from which it could be reclaimed.

The charging hopper of the 1-yard Smith mixer was gauge marked to indicate the proper proportions of sand, crushed stone and cement, the latter being delivered as required in 6-bag batches by a belt conveyor from the store house. The mixer discharged into a 2-yard hopper, from which were filled the 2½-ton end dump short-wheel-base automobile trucks by which the concrete was conveyed to the road, where it was spread with a horse-drawn scraper.

The trucking was facilitated by the sequence of concreting, which was commenced 1½ miles south of the plant and after it had progressed to the plant was recommenced 1½ miles north of the plant working again toward the plant and thus producing a 3-mile stretch of finished hard-surfaced road, over which the trucks traveled to deliver the concrete to the 1⅝-mile section remaining at each end.

Pneumatic Concrete Mixer for Jap Tunnel

Special compressed air machine designed for lining Imperial Japanese Government Railways tunnels.

In January, 1920, three pneumatic concrete mixers, designed for lining the Imperial Japanese Railways tunnels, were shipped to that country from the United States by the Ransome Concrete Manufacturing Company. Each machine has a capacity of about 10 feet of loose aggregate, equivalent to a 7-cubic-feet batch of mixed concrete, per minute, delivered about 100 feet through a 6-inch cast iron pipe by about 1,000 cubic feet of free air per minute at a pressure of 85 to 100 pounds.

The machine, which weighs about two tons, and requires one man to operate it, is mounted on a steel frame truck of 30-inch gauge, intended to run on one of the two tracks laid on the tunnel invert with clearance alongside for muck or material cars to pass it.

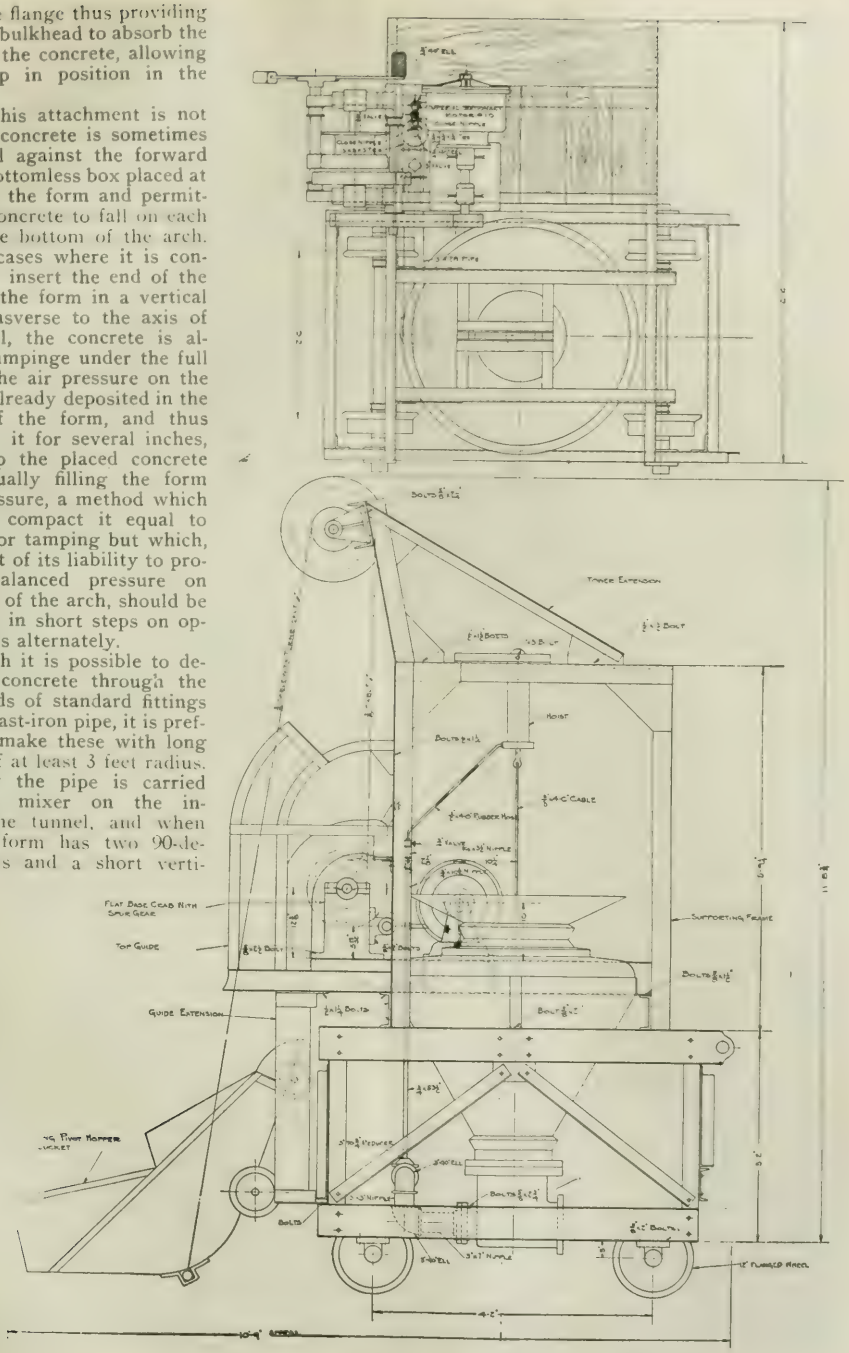
DEPOSITION OF CONCRETE

Although the mixer is capable of delivering concrete 600 feet horizontally and 40 feet vertically, it is preferable to attach it to the rear of the form and move it forward with the form, thus delivering the concrete through a short section of pipe which often terminates with a blank flange and has a hole in the bottom part of the pipe just

behind the flange thus providing a baffle or bulkhead to absorb the impact of the concrete, allowing it to drop in position in the forms.

When this attachment is not used, the concrete is sometimes discharged against the forward end of a bottomless box placed at the top of the form and permitting the concrete to fall on each side to the bottom of the arch. In other cases where it is convenient to insert the end of the pipe into the form in a vertical plane transverse to the axis of the tunnel, the concrete is allowed to impinge under the full force of the air pressure on the concrete already deposited in the bottom of the form, and thus penetrates it for several inches, forcing up the placed concrete and gradually filling the form under pressure, a method which serves to compact it equal to ramming or tamping but which, on account of its liability to produce unbalanced pressure on both sides of the arch, should be carried up in short steps on opposite sides alternately.

Although it is possible to deliver the concrete through the short bends of standard fittings of 6-inch cast-iron pipe, it is preferable to make these with long sections of at least 3 feet radius. Ordinarily the pipe is carried from the mixer on the invert of the tunnel, and when near the form has two 90-degree bends and a short verti-


Bolts
Truck Extension
Hoist
Flat Base Gear with Spur Gear
Top Guide
Supporting Frame
Guide Extension
Bolts
Bolts
Bolts

cal section which brings it near the crown of the tunnel, where there is screwed into the upper horizontal part the end of a 30-foot length of special heavy 6-inch hose with one-quarter-inch rubber lining and an eight-ply external fabric, making it very stiff and strong. It is provided at each end with a nipple and it has been found that it can be bent in a complete circle or letter "S" and still deliver the concrete satisfactorily and will wear about six times as long as a cast iron bend of the same shape and radius of curvature.

Where it is convenient to maintain a mechanical mixer close to the forms, the mixed concrete can advantageously be delivered to the pneumatic hopper through the power loader hopper, but when the distance is long, the dry aggregate and cement are delivered in batch cars or boxes to the loader hopper and by it dumped into the pneumatic mixing hopper, after which water is added, the hopper closed, the pneumatic pressure admitted, and the mixing almost instantly accomplished.

It is found that the transmission of the concrete through the delivery pipe induces a sort of rolling motion that insures a thorough mixture even in a distance of 20 feet. Care, however, is taken not to allow the concrete to be ejected more than three or four feet beyond the end of the pipe because of the liability to segregation; therefore it is projected as already described against some solid surface equivalent to a baffle board, thence falling by gravity in a homogeneous mass.

JAPANESE METHOD

An interesting feature of the Japanese practice is the method of handling the three-quarter-yard muck and material cars, each of which is provided with a small platform front and rear, on which one laborer rides while two laborers push the loaded car on the tunnel track. At intervals they change places with the man that rides and keep up this practice all day, pushing the cars at the rate of a half-mile trip in six minutes or even less.

The pneumatic machine operated both as a portable mixer and as a concrete conveyor, is especially advantageous for long tunnels where mixed concrete is in danger of acquiring a preliminary set before it can be delivered to the conveyor. In this Japanese work there is a tunnel fifteen miles long that has been designed entirely for use as a service tunnel for the construction of an important hydro-electric plant in a mountain region otherwise inaccessible for the delivery of plant, materials or laborers.

One of these three machines is now in service on the Musachi hydro-electric development under the supervision of Mr. Tsuruta, managing director, who visited America and selected the type of machinery here described. Duplicate parts for the door and lever, the only movable portions of the machine, were shipped with it to provide against delay for renewal. Duplicate parts were also shipped for the air motor and for the power loader. Records of the service of this machine have not yet been received, but a similar machine, with a capacity of ten feet of mixed material and differing only in size, has given a record of 1,753 cubic yards in six 20-hour shifts in the Liberty tunnel, Pittsburgh.

Serving Concrete Paving Mixers from Central Storage Plants

Speed and economy promoted by the use of light automobile trucks with short wheel base equipped with divided end-dump body, or platform with batch boxes, or duplex tilting hoppers.

Route 225 of the Pennsylvania State Highway, between the Baltimore Pike and the Westchester Pike, Delaware county, is five miles long and has a Warrenite surface 18 feet wide laid on a concrete foundation 6 inches deep, except for 1,900 feet, where there is 5 inches of concrete surfaced with brick. Sand and slag were stored in large elevated hopper-bottom bins with gates discharging into measuring boxes under which automobile trucks with their bodies divided by transverse partitions into two equal compartments could be backed and filled successively with the required quantities of slag and sand for two separate batches of concrete and then moved to the adjacent cement house where three bags of cement were added to each batch, the whole operation occupying only 2 or 3 minutes.

Trucks were driven a maximum of three miles over good roads and three miles over heavy subgrade to the mixer, but turned around without difficulty on an 18-foot roadway, the cement bags were emptied on the aggregate and thrown aside to a safe place, the truck backed up, the body tilted by the truck engine and the first batch discharged into the mixer. The truck was then moved forward a few feet permitting the charging skip to be elevated to discharge to the mixer and returned to the ground when the truck backed up again, its body remaining elevated, and the second batch was dumped into the skip and the truck moved away, permitting another one to take its place at the mixer while the first truck returned to the storage bins.

The entire unloading operation for each truck required about two minutes. The work was arranged to keep the trucks constantly in operation. Twenty were used for the long hauls and afterwards, when a second mixer was installed, ten were used for short hauls. The trucks were equipped with 6-inch rear tires that enabled the 11,000-pound maximum load to be carried without difficulty over the sub-grade and the short wheel base enabled them to be turned easily in the 18-foot width of the road. It was estimated that this method of handling the concrete material dry from central storage effected a saving of 16 men, equivalent at current prices to 8 or 10 cents per square yard of concrete. The materials were hauled by Howard B. Greene, Swarthmore, Pa., sub-contractor.

The Weller Construction Co., Washington, D. C., hauled aggregate three or four miles from storage to the concrete mixer on Route No. 127.

Section No. 3, of the Baltimore-York Pike, Pennsylvania, with ten automobile trucks equipped with platform bodies, pneumatic tires and each of them loaded with two steel batch buckets.

Sand, broken stone and cement, delivered by railroad, were handled by clam-shell bucket operated by the boom of a traveling derrick which filled an elevated hopper, under which the trucks were driven and rapidly loaded. The batch boxes were unloaded from the trucks by a power derrick attached to the mixer, and the concrete was laid at a maximum rate of 500 linear feet of 18-foot pavement daily.

On a 9-mile section of the Franklin Canyon Highway, California, Ryan Bros., the contractors, served the concrete mixer with four small automobile trucks with dump bodies that brought the materials from central storage, displacing fifteen large trucks previously employed on the job, because the latter could not turn without backing between the header boards, and were consequently obliged to run beyond the ends of the header boards before the next truck could approach the mixer. In this case the road was built with two 8-foot strips of concrete pavement, separated by a 4-foot strip of macadam.

A 12-mile section of the Jefferson Highway, near Des Moines, Ia., was built with concrete for which the aggregate and cement were hauled from the railroad a maximum of four miles over dirt road and one and a half miles over the subgrade by the Wright Construction Co., which used 1½-ton and 2-ton automobile trucks with platform bodies equipped with Lee end-dump dual-hopper bodies. Each car made the round trip in 14 minutes, so that the six trucks moved a total of 180 tons of dry materials in one 10-hour day.

On all of the above jobs the trucks used were "Autocars" with a 97-inch wheel base, which could easily be handled in cramped positions and were considered speedy, economical and satisfactory.

Trackless Trolleys

Richmond, Va., and Richmond borough, N. Y., Greenville, Texas, and possibly other cities are considering the use of trackless trolleys in place of either street railways or motor busses. In view of the increasing interest in the matter, a practical demonstration of a trolley bus will be made at the Schenectady works of the General Electric Company the latter part of May.

Trackless trolleys have been successfully operated for several years in European countries, more than 100 miles being covered by this service in England, while in Italy 8 companies cover 43½ miles with satisfactory results. Installations of this nature were made in California and in Wisconsin several years ago but for some reason were not adopted.

If used in Richmond, Va., they will serve to supplement the present railway system; while Greenville is considering using them to replace the present rail routes.

The car to be demonstrated at Schenectady is a 30-passenger type, similar in external appearance to the [illegible] trolley car, except that it has rubber tired wheels. With a sliding trolley pole, the trackless trolley has a practicable width of route of 18 feet, 9 feet on either side of the trolley wire, which gives it ample facilities for passing other vehicles on the street. It is operated similarly to automobiles, steering being done by a large circular wheel and power being applied by a foot pedal. Directly over the head of the driver is a lever by which the trolley pole can be pulled from the wires in passing, where cars are operated in both directions on a single line.

The chief advantage over the regular trolley system is the low initial capital investment, while as compared with the motor bus, the operating and maintenance cost is much less. As compared to a cost of $35,000 a mile for installing a single-track trolley line on an unpaved street, or $75,000 on a paved street, the overhead for a single trackless trolley costs from $5,000 to $7,000 and $2,000 additional for a double set of wires. It is stated that operating a motor bus costs an average of 5 cents a mile for gas and oil, while the cost of the electricity for the trackless trolley is 2 cents a mile. It is also claimed that the maintenance of equipment, including tires, is almost twice as great for the motor bus as for the trackless trolley.

Refuse Collection by Motor Vehicles

A report has been made to the public health committee of the metropolitan borough of Hackney, England, by R. Scorgie, giving data concerning the use of motor vehicles in the collection of house refuse in Sheffield, Nottingham and Leyton. From his study of the services in these three cities Mr. Scorgie has drawn the following conclusions:

That removal of house refuse by mechanically propelled vehicles is advantageous and economical when expedition in collection is obtainable.

That to secure economy by the use of mechanically propelled vehicles for house refuse collection, it is essential that a continuous collection be made and that "waiting time" is entirely avoided.

That electric vehicles are suitable for the work if the conditions of working warrant the use of mechanically propelled vehicles.

The electric vehicles are easy to manipulate and work and are economical in working, but are more costly to purchase than other kinds of mechanically propelled vehicles.

That to secure economy and efficiency by the use of mechanically propelled vehicles in Hackney, the calling at and the entry of the workmen into houses and private premises must be abandoned.

That more frequent collections should be inaugurated, and the occupiers of all premises required to place the refuse in suitable receptacles on the footways or in accessible situations at times to be specified.

That it is expedient that a trial of the use of mechanically propelled vehicles in this district should be undertaken by the purchase of 3 or 4 vehicles before any general scheme is adopted, such vehicles being used in different areas of the borough, with the view to obtaining reliable data of cost under such improved conditions of working as can be adopted in the district.

That the present price of electric vehicles may be approximately assumed to be: 2-ton capacity, £1,300; 3½-ton capacity, £1,600, and that a 5-unit charging station necessitates an expenditure of about £1,500.

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems differently will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

What Are the Best Methods of Handling Gravel from Car to Concrete Mixer?

By gravity alone, when conditions are favorable. By mechanical equipment and gravity combined or by mechanical equipment alone. Clam-shell, orange-peel and even drag-line buckets, derricks, gantries, locomotive cranes, belt and bucket conveyors, elevated bins, dump cars and chutes, are most common items of plant installed. Small amounts can be handled entirely by hand.

(*Continued from Page* 437)

GANTRIES

Cars can be unloaded by a bucket operated from a gantry, which in this case is substantially a trestle bent spanning the railroad track or tracks with vertical and horizontal clearance through it sufficient for the train service and the storage bin or storage pile. In its simplest form it consists of a horizontal beam or girder transverse to the track, supported at each end on a braced or guyed vertical post and having the buckets suspended from it at a sufficient height to permit it to be swung pendulumlike from the car to the storage bin. This, however, would usually be too high for convenience and the bucket may be suspended instead from a trolley running the full length of the horizontal beam and traversed back and forth by a line operated by hand or by the hoisting engine. In this case the beam or girder may be made double with the trolley running between the two parts and it may be supported on A-frames in planes parallel to the railroad track, thus bracing it and giving it independent stability if the A-frames are knee-braced to the cap with inside or outside struts or ties.

The horizontal reach of the gantry may be increased by cantilevering one end of the beam beyond the support provided for the passage of the bucket through the frame while the opposite end of the beam is counterweighted. A gantry can be made fixed or it can slide on skids under the sills of the A-frames or the latter may be provided with wheels or trucks operated on single rails, one on each side of the track. If the gantry is movable the hoisting engine should, of course, be mounted on it.

LOCOMOTIVE CRANES

One of the most convenient and efficient methods of unloading gravel from cars is with locomotive cranes, which, if they are easily available, are equally cheap for handling one carload or a thousand carloads. They are standard equipment for many kinds of construction operations and are very easily shifted from place to place, can be used singly or in multiple, are very flexible in their operation, can be transferred without delay from stock pile to storage bin, and from loading to unloading and from that to reclaiming and can, without extra expense, be interrupted at any time and shifted to any other work without delay or difficulty. The boom is usually long enough to command an elevated storage bin or a stock pile of ordinary size or an extension boom can be easily applied. The cranes may be mounted on trucks to run on standard or special gauge tracks, on board face wheels running on the highway or on caterpillar tractions, with which they can go over very soft, steep or rough ground without roads.

In cases of emergency the work can be performed by derrick cars and by special machines with derricks fitted on portable platforms. The derricks may also be installed on ordinary flat cars if there is a standard gauge track available alongside the track on which the gravel cars are delivered.

BELT AND BUCKET CONVEYORS

The gravel car may discharge directly by dumping or indirectly by buckets to a track hopper or other hopper, in which is installed the boot of a bucket elevator, or which delivers through a hopper bottom to a belt conveyor. The bucket elevator is usually operated on a steep incline and carries the gravel to an elevated storage bin, or can dump it to an elevated hopper from which it is discharged on a storage pile or to a chute or conveyor that will transfer it horizontally. The bucket elevator can be of any reasonable dimensions, usually from 20 to 50 feet in length. It is driven by any convenient motive power and can be had in commercial sizes and types with buckets of different pattern and capacity.

Belt conveyors can be purchased of the manufacturer with various widths and length, and can

be installed in any position from horizontal to an incline of 20 degrees or more from the horizontal. They should be troughed to secure maximum capacity, and are driven by any convenient motor power. They can be purchased in any required length from 10 feet upward, and can usually be most advantageously installed with one or more horizontal or inclined sections 25 to 50 feet long, thus providing a very flexible system for conveying the gravel in any direction and to any elevation.

If provided with a system of regular uniform feed they are automatic in operation, and like the bucket elevator, have a tremendous capacity and afford very economical service if operated continuously. They can be made to deliver at the end of the line or at any intermediate point and like the bucket elevator, can deliver into one or several different compartments of the storage bin.

Belt conveyors may be operated from storage pile to storage bin when the former is not provided with hoppers if the belt is installed in a tunnel passing under the full width of the pile and having horizontal gates in the roof of the tunnel through which the gravel can be delivered to the belt from any part of the pile thus commanded. Ordinary arrangement permits most of the pile to be reclaimed with very little reshoveling.

STORAGE BINS

Storage bins should, if possible, be located adjacent to the mixer at the point where the batch boxes are filled. They can be made of any convenient type or dimensions. If they are not designed and located so that the concrete mixer can be supplied by gravity directly from the main storage bin, there should be a small storage bin above the mixer so that its contents can be discharged by gravity directly into the charging hopper unless the mixer is supplied with gravel furnished in measuring boxes.

For providing a direct supply to the mixer, measuring boxes or to cars or trucks, the storage bin should be elevated to deliver the gravel by gravity when the proper valves or gates are opened. The bins, with vertical walls and open tops, are usually of heavy timber construction, and are divided for storage of sand and gravel, or for gravel of different dimensions. In severe climates where concreting is to be carried on in freezing weather, steam coils may be installed in the bottom of the bin to prevent the wet gravel from freezing.

If the bottom of the bin is made horizontal and the gravel delivered through gates or valves in the bottom or at the lower edge of one or more vertical walls, a little shoveling will be necessary to discharge all of the gravel in the bottom of the bin. This is not, however, usually an important consideration, because the gravel will automatically take a natural slope, delivering most of the contents of the bin without difficulty, and as the bin is constantly replenished only a very small amount of the gravel handled is actually dead material, and the expense of special bin bottom construction and the loss of maximum storage space is unnecessary.

GATES AND VALVES

The gravel can be discharged through rectangular openings at the bottom or lower side of the bin that are commanded by sliding steel gates operated by levers. Care must be taken not to make the surface of the gates too large or the pressure and frictional resistance will make their operation difficult. The gate should work against steel or iron bearings that are well lubricated with heavy grease. Special steel or cast iron gates or valves suited to all sorts of bins and requirements of delivery can be purchased.

If the gravel is discharged through an opening in the vertical wall of the bin its flow can be effectively controlled by means of a trough of any required length that is pivoted at the upper end to the wall just below the bottom of the opening and can revolve in a vertical plan with the upper end of the trough engaged between a pair of vertical wing plates forming the sides of a short fixed trough or spout. The pivoted trough should have the outer end suspended and balanced by a counterweight so that it can easily be revolved upwards, cutting off the flow of the gravel through the opening, and readily dropped downward to any convenient position, regulating the rapidity of the flow of gravel into the bucket, car, or hopper receiving it. Such a home-made arrangement can easily be installed to deliver the gravel several feet away from the bin.

Fixed spouts may be attached to the openings in the storage bin and provided with double gates enclosing between them a space sufficient for one batch of gravel. The gates can be connected so that one is always closed when the other is open, and thus their operation automatically discharges a measured quantity of gravel every time.

If a separate storage bin is required for the mixer it is advantageous to have it located so that it can be filled by gravity with gravel chuted from the main storage bin. If the gravel is discharged through openings in the side of the bin a space under the bin floor may be enclosed and used for storage or other purposes.

Pennsylvania Highway Work

Highway work has started with a good impetus in Pennsylvania, the State Highway Department reporting on May 12 that it had completed 39.44 miles of durable construction in various parts of the state this year. This is more than double the construction for the same period in 1920.

Survey of the state disclosed a large number of unemployed men in every community, which number is increasing weekly. "The highway department is anxious to relieve this situation insofar as the contracts under its direction will afford employment. In view of the fact that practically all communities are affected alike and that there is available a local supply of labor for all our existing contracts, our contractors are being urged to seek the services of men living in the community in which they are operating rather than to import labor from a distance; and especially are they being urged not to interfere with such labor as is, or will be, employed on farms of the commonwealth."

Paving Materials in Various Counties

Reports from hundreds of counties throughout the United States telling where contractors can obtain stone, gravel and sand that will be satisfactory to county engineers for use in concrete, macadam and gravel road construction.

In connection with other data collected by us from county highway officials during March of this year was information concerning the availability in each county of stone that would be acceptable for either concrete or macadam, gravel acceptable for either of these purposes, and sand for concrete. In each case the question was whether such material could be obtained within the county, and if not, how far it was to the nearest quarry or bank from which such material could be obtained. Our idea was that this information would be valuable to contractors who might at any time contemplate bidding upon highway work in any of these counties. In a general way also, it gives a survey of the local material situation throughout the country, which may aid in explaining cost prices, the reason for adopting certain classes of construction in a given county, and in other ways.

In the following we have given the answers returned from the several counties in as condensed a form as possible, at the same time endeavoring to so present the matter that it can be referred to conveniently.

The questions asked are given herewith and, in giving the replies, each will be referred to by the letter attached to it in this list:

A. Are there any quarries in the county from which can be obtained stone acceptable for concrete?

B. For macadam?

C. If not, how far is the nearest quarry?

D. Are there any banks in the county from which can be obtained gravel acceptable for concrete?

E. For gravel roads?

F. If not, how far is nearest bank?

G. Are there banks in the county from which can be obtained sand acceptable for concrete?

H. If not, how far is the nearest bank?

ALABAMA

Calhoun—A yes, B yes, D yes, E yes, G yes.

ARKANSAS

Conway—A yes, B no, C 50 miles, C yes, E yes, G yes.
Jackson—C 100 miles, D river gravel banks, G yes, river bar sand.
Monroe—A no, B no, C 150 miles by rail, D yes, in abundance, E yes, well distributed, G yes.
Montgomery—A yes, B no, C 90 miles, D yes, E yes, G yes.
Pike—A no, B no, C 50 miles, D no, E no, F 50 miles, G yes.
Lincoln, Drew, Desha, Chicot and Ashley—A none, except sand and gravel from Mississippi river, B some bank deposits, D no, E yes, G no.
Polk—A yes, B yes, D river gravel, E no, F 60 miles, G river sand.
Pulaski—A yes, B yes, D no, E no, F 43 miles, G yes.
Scott—A yes, B yes, D yes, E yes, G yes.
Seveier, Saline and Lincoln—A no, B no, C by rail average 100 miles, D yes, in all cases, E yes, G yes in all, H every few miles.
Van Buren—A no, B no, C 40 miles, D no, E no, F 100 miles, G no, H 100 miles.
Washington—A yes, B yes, D few, E yes, G no, H 60 miles.

CALIFORNIA

Fresno—A yes, B yes, D yes, E yes, G yes.
Glen—A yes, B yes, D yes, E yes, G yes, sand tests 23 per cent stronger than Oaaowa sand.
Madera—A no, B yes, D yes, E yes, G plenty in different places.
Riverside—A yes, B yes, D yes, E yes, G yes.
San Benito—A yes, B yes, D yes, E yes, G yes.
Solano—A yes, B yes, D yes, from creek beds, E yes, from creek beds, G yes, from creek and river beds.
Sutter—A no, B no, C 40 miles by railroad, D no, E yes, G yes, river run, H screened sand in adjoining county.
Ventura—A no, E yes, G yes, H river beds.

COLORADO

Elbert—A no, C 60 miles, D plenty of sand, E yes, F handy to mostly all roads, G yes, H handy to mostly all places where needed.
Fremont—A yes, several, D yes, several, G yes, several.
Lake—A plenty of them, B yes, D yes, E yes, G yes.
Logan—A none, B none, E yes, G yes.
Ouray—A abundance of sand and gravel, B lots, D yes, E yes, G river sand.
Rio Blanco—A yes, B yes, D yes, E yes, G yes.
Rio Grande—A yes, B yes, D yes, E yes, G yes.
Routt—A yes, B yes, D yes, E yes, G yes.
Weld—A no, B no, C 50 miles, D yes, E yes, G yes.

CONNECTICUT

Litchfield—A none, B none, C 50 miles, D yes, E yes, G yes.
Fairfield—A no, B no, C New Haven, D no, E only fair, F doubtful, G no, H Long Island.
New Haven—A yes, B yes, D yes, E yes, G yes.
New London, Windham, Tolland—A yes, B yes, D yes, E yes, G yes.

DELAWARE

New Castle—A yes, B yes.

FLORIDA

Bay—A no, B no, C no, D adjoining county, E adjoining county, F county owns 320 acres adjoining county, G yes.
Bradford—A none, B no, C 50 miles, D yes, E yes, G yes.
Duval—A no, B no, C Columbia, S. C., D no, E no, F Montgomery, Ala., G out of river, H sand generally shipped in haul 50 to 150 miles.
Escambia—A no, B no, D yes, E yes, G yes.
Flagler—A yes, rock, D no.
Pinellas—A no, B no, C 75 miles, D no, E no, F 150 miles, G yes, limited quantities, H Lake Wier sand 100 miles, Alifia river sand 25 miles, both pass government specifications.

IDAHO

Ada—A yes, B yes, D lots of them, E lots of them, G yes.
Bannock—A yes, B yes, D yes, E yes, G yes.
Benewah—A none opened, plenty available, B none, plenty available, D no quantity, E no, F 60 miles, G yes, fair.
Boise—A no, B no, D yes, E yes, G yes.
Butte—A yes, B yes, D yes, E yes, G yes.
Caribou—A yes, B yes, D yes, E yes, G yes.
Custer—A yes, B yes, D yes, E yes, G yes.
District No. 1, Bureau of Highways—A yes, B yes, except Bear Lake, D yes, E yes, except Bear Lake, G yes.
Idaho—A yes, B yes, D yes, E yes, G yes.
Power—A yes, B yes, D yes, E yes, G yes.
Washington—A yes, D yes, E yes, G yes.

ILLINOIS

Adams—A yes, B yes, D no, E yes, G yes, H plenty of good sand and gravel in Mississippi river.
Calhoun—A unlimited amount of limestone bluffs, B same, D none, E creek gravel, G none, H Mississippi river and Illinois river sand.
Carroll—A 3 in use, B 3 in operation, D yes, E yes, G yes.
Christian—A no, B no, C 90 miles, D no, E yes, G no, H 70 miles.
Clark—A plenty of limestone, no quarries working, B no, C 50 or 60 miles, D yes, E yes, G yes.
Coles—A no, B no, E yes, F 80 miles, G no, H 80 miles, Terre Haute, Ind.
Crawford—B none, C 5 miles, D yes, E yes, G yes.
DeWitt—A no, B no, D no, E yes, G no.
Fulton—A yes, B no, D natural deposits, E yes, G yes.
Henderson—A yes, B yes, D no, G yes.
Jackson—A yes, B yes, D yes, E yes, G no, H 26 miles.
Jasper—A no, B no, C 150 miles, D no, E no, F 35 miles, G none, except bars along river, H 35 miles.
Jersey—A yes, B yes, D no, gravel in creeks, G no banks, but good gravel in creeks.
Kane—A no, B yes, D yes, E yes, G yes.
Madison—A yes, B yes, D yes, E yes, G yes.
Marion—A no, B yes, D yes, E yes, G yes.
Massac—A in infancy, B same, C White Hill (20 miles), D 50 open pits, E numerous, F numerous, G numerous, H numerous.
McDonough—A none, B none, D none, E no, G no.
McHenry—A no, B no, C 2½ miles west of county line, D yes, great many, E yes, great many, G yes.
Monroe—A yes, B yes, D no, E no, G no.
Piatt—A no.
Pike—A unlimited quantities, B stone pretty soft, C some good local quarries, D from streams, but must be washed, E from streams, unlimited, G yes, but must be washed.
Pulaski and Alexander—A limestone deposits, B not being worked, C 18 miles (White Hill), D numerous ones, E numerous, G river bars only.
Richland—A no, D none, G yes, H several creeks with good sand from 3 to 5 miles.
Saline—C 90 miles, D no, F 40 miles, H 40 miles.
Schuyler—A no, B no, D yes, E yes, F located at Frederick, G yes, H on railroad.
Scott—A no, B no, C 25 miles, D yes, E yes, G yes.
Stephenson—A no, B yes, C for concrete 75 miles, D about 3, E yes, G yes, pit run.
White—A no, B no, C 60 miles, D river gravel along boundary, E along boundary, G no, H along boundary.
Williamson—B no, E no, G no.
Woodford—A no, B no, C 100 miles, D no banks, some wash gravel in stream beds, E none accepted by state, F 25 miles, G yes, if washed.

INDIANA

Clinton—A none, B none, C 25 miles, D yes, E yes, F most concrete material shipped 25 miles, G yes.
Crawford—A yes, B yes, D none except in river, E in river only, F none accessible, G from Ohio river.
Decatur—A yes, B yes, D no, E yes, G no, H 25 miles.
Dubois—A yes, in north end of county, B yes, in north end of county, C for work other than north end stone is shipped about 40 miles, D yes, along White river on north end, E no, F 55 miles for south and central sections, G along White river on north end, H for south and central portions 55 miles.
Fulton—A none, C 23 miles, D yes, E yes, G yes.
Hendricks—A none, B none, C train 30 miles, truck 15 miles, D little creek gravel, but all should be screened and most washed, E yes, G no, H washing plants 20 miles away.
Howard—A yes, B yes, D [illegible], E yes, [illegible]
Jackson—A yes, west part, [illegible] D no, use White river, E [illegible] miles, G White river, H none, use White river.
Jennings—A yes, B yes, D [illegible] obtained, H from streams for concrete.
Madison—A yes, B yes, D yes, E yes, G yes.
Martin—A plenty of them, B yes, D yes, E yes, [illegible] fork White river furnishes all that will be needed.
Montgomery—A no, D yes, E yes, G yes.
Morgan—A yes, B yes, D yes, E yes, G yes.
Newton—A yes, B yes, D yes, E yes, G yes.
Orange—A yes, B yes, D yes, for small contracts, E [illegible] F 30 miles, G no, H 30 miles.
Posey—A no, B no, C 90 miles, D yes, E yes, G yes.
Putnam—A plenty, B several, C in all townships, D several and creek bars, E several, F we ship some gravel, G generally use washed bar gravel.
Ripley—A yes, B yes, D none, E yes, G yes.
Shelby—A yes, B yes, D yes, abundant fine gravel, E Yes, G yes.
Spencer—A no, B no, C 50 miles, D no, E no, F Ohio river adjoins county, G no, H Ohio river adjoins county.
St. Joseph—A no, B no, C 60 miles, D yes, E yes, G yes.
Tippecanoe—A no, B no, C 30 miles, D yes, E yes, G yes.
Vigo—A no, B no, D yes, E yes, G yes.

IOWA

Allamakee—A yes, B yes, D yes, E yes, G yes.
Appanoose—A no, B no, C 90 miles, D no, E no, F 45 miles, G no, H 45 miles.
Beton—A yes, B yes, D yes, E yes, G yes.
Bremer—A no, B no, C 100 miles, D very few, E some, G no, H 30 miles.
Buena Vista—A no, B no, C 100 miles, D yes, E yes, G yes.
Cass—A no, B none, C none in southwest Iowa, D none, E none, F Lake View or Des Moines, G none, H Lake View or Des Moines.
Cedar—A yes, none in operation, B yes, none in operation, D sand in Cedar river, E none, G sand in Cedar river.
Cerro Gordo—A yes, B yes, C 2 miles, D yes, E yes, F 2 miles, G yes, H 2 miles.
Chickasaw—A yes, B yes, D yes, E yes, G yes.
Clay—A no, B no, D yes, E yes, G yes.
Crawford—A no, B no, D yes, E yes, G yes.
Dallas—D yes, E yes, G yes.
Delaware—A none, B yes, D yes, E yes, G yes.
Des Moines—A yes, but not paving concrete, B yes, D yes, Mississippi river, E yes, F Muscatine, Ia., G yes, Mississippi river, H Muscatine, Ia.
Dickinson—A no, D yes, E yes, G yes.
Dubuque—A yes, B yes, D no, E no, G Mississippi river gravel.
Emmet—A no, B no, D yes, E yes, G yes.
Floyd—A yes, B yes, D yes, E yes, G yes.
Grundy—A yes, all limited, B yes, D no, E yes, G yes.
Guthrie—A none, B none, D no, E yes, F 30 miles, G yes.
Hamilton—A none opened up, B none open, C 30 miles, D yes, E yes, G yes.
Harrison—B none, C 100 miles, D yes, E yes, F 75 miles, G yes, H 75 miles.
Iowa—A no, B none, C 70 miles, D no, E no, F 70 miles, G yes.
Jasper—A no, C 90 miles, D no, F 35 miles.
Johnson—A yes, B yes, D no, F 75 miles, G river.
Kossuth—A no, B no, C 20 miles, D no, E yes, F 20 miles, G no, H 20 miles.
Linn—A yes, B yes, D yes, but it must be washed, E yes, G yes.
Lucas—A no, B no, C 60 miles, D no, E no, F 50 miles, G no, H 60 miles.
Lyon—A yes, B yes, D yes, E yes, G yes.
Madison—A abundant supply, B yes, C along road site, D no, E no, G no, H 15 miles.
Mahaska—A no, B no, D no, E one, G no.
Marshall—A county owns one, B yes, D yes, E yes, G yes.
Monona—A no, B no, D no, E yes, F 70 miles, G yes.
Monroe—C at northeast corner.
Montgomery—A no, B no, C 75 miles, D no, E no, F 100 miles, G no, H 75 miles.
Muscatine—A no, B no, D yes, E yes, G yes, H yes.
O'Brien—A no stone, but fair quantity of good gravel and sand, C 60 miles, D yes, E yes, G yes.

To be continued

Recent Legal Decisions

EXEMPTION FROM TAXATION OF MUNICIPALITY'S ELECTRIC PLANT SITUATED WITHOUT THE MUNICIPALITY LIMITS

The Connecticut statute, Gen. St., 1918, par. 1160, provides that buildings with their appurtenances belonging to any county, town, city or borough "shall be exempt from taxation." The Connecticut Supreme Court holds that in the light of the common law this provision should be treated as if it exempted from taxation all property held by municipalities for public use. It is the recognized law that the furnishing of electricity to the public for light, heat and power for pay is a public use for which the power of eminent domain may be exercised. It is now the common law of Connecticut, and in substantially all the states, that a municipality which, acting under legislative authority, maintains and operates a public service plant and furnishes water or gas or electricity, for light, heat and power to itself, and to its inhabitants for pay, holds such plant for a public use. The great weight of authority holds that such a plant is exempt from taxation wherever situated within the state of the municipality. Applying these principles it is held, Town of North Haven v. Borough of Wallingford, 111 Atl. 904, that a municipality's electric plant is exempt from taxation though located in another part of the state. Where the defendant borough acquired, from plaintiff town, for its electric plant, water power and land on which stood a gristmill, on condition that the mill was kept fit for service, the running of the mill as an incident to the maintenance of the water power, and the mere receipt of a trifling revenue which went into the borough treasury did not render the mill subject to taxation.

REGULATION OF RAILROAD CROSSINGS BY A CITY WITHIN ITS LIMITS

The Florida Supreme Court holds, City of De Funick Springs v. Louisville & Nashville R. Co., 87 So. 47, that where a railroad is operated over a street that divides the city into two parts, so that it is impossible for the public to go from one part to the other without passing over the railroad tracks and right of way, the city, under its police power, for the protection of the railroad and the safety of the public, may prohibit the passage over the railroad tracks and right of way by the public except at such points as the city may designate, and may require the railroad to provide safe and convenient means of passage at such places. The public has a right to go from one part of the city to the other, and this right is superior to the right of the railroad to maintain its tracks and operate its trains through the city. The city council has the right, in the exercise of a sound discretion, to determine at what points the public shall cross the right of way and tracks, and may establish such points as are required for the convenience of the public in the transaction of its business or for such other purposes as are common to the inhabitants of a city.

CONTRACTORS INDISPENSABLE PARTIES TO SUIT TO RESTRAIN CITY FROM COMPLYING WITH CONTRACT

In a suit by taxpayers to enjoin a city making payment to contractors, the Texas Court of Civil Appeals holds, 227 S. W. 505, that the contractors are indispensable parties to the suit, its sole object being to have the court declare their contract with the city invalid and restrain the city from complying with its terms; and the court cannot do this so as to bind the contractors unless they are parties to the suit. It is also held that the Appellate Court must take notice of the fact that they are not made parties though the point has not been raised in either the trial or the Appellate Court.

REGULATION OF MUNICIPALLY OWNED PUBLIC UTILITIES

The Indiana Public Utilities Commission is of opinion that Section 112 of the Public Service Commission Act makes unlawful free service or service at special rates to any consumer of a municipal utility, and that the practice of furnishing free service, or service at special rates, therefore, has been unlawful since the passage of the act in 1913. Whether a town could recover from a charitable institution bills for water and electricity furnished by the municipal plant, dating back to the passage of the act, is a question of law over which the commission has no jurisdiction.

The Indiana Commission is of opinion that where a municipality owns and operates water and electrical utilities, the municipality should have on file with the commission rates for both street lighting and fire hydrant service, and that the amounts due under its rate schedules should be paid by the municipality to the utilities in cash, and credited to the utility as revenue; the funds necessary to make such payments to the utilities to be raised by taxation.

EXTENSION OF WATER MAINS

On the complaint of the borough of Tionesta and a number of individuals as to the failure of the Tionesta Water Supply Company to make an extension of mains, to which the company objected on the ground that the resulting revenue would not be sufficient to justify the expenditure required, it appeared that the extension would not only be a public convenience to a considerable number of prospective water consumers, but was a real public necessity from the standpoint of fire protection. It was admitted that the prospective returns upon the investment would not be sufficient of themselves to meet reasonable annual charges placed upon the extensions at present, but the Pennsylvania Commission held that, as it did not seem that the burden upon the general revenues of the company would be oppressive or unreasonable, the extension should be made, provided the borough on its part arrange for sewerage.

NEWS OF THE SOCIETIES

May 31-June 3—NATIONAL ELECTRIC LIGHT ASSOCIATION. Pasadena, Cal.

June 1-2—CONFERENCE OF STATE SANITARY ENGINEERS Hotel Bellevue Boston, Mass.

June 2-4—GOVERNMENTAL RESEARCH CONFERENCE Philadelphia, Pa. Secretary, Dr. L. D. Upson, 542 Griswold St., Detroit, Mich.

June 3—AMERICAN ENGINEERING COUNCIL, FEDERATED AMERICAN ENGINEERING SOCIETIES St. Louis.

June 5-10—TRI-STATE WATER AND LIGHT ASSOCIATION Asheville, N. C. Secretary, W. F. Seabolt, Columbia, S. C.

June 6-10 AMERICAN WATER WORKS ASSOCIATION Annual convention, Hollenden Hotel, Cleveland Secretary, J. M. Diven, 153 W. 71st st., New York City.

June 7-10 KENTUCKY STATE ROAD ENGINEERS Annual convention Armory Louisville, Kentucky.

June 10—ROCHESTER ENGINEERING SOCIETY Annual meeting Election of officers Rochester Engineering Society Rooms.

June 13-14 CLEVELAND SECTION AMERICAN SOCIETY OF MECHANICAL ENGINEERS Regional meeting Great Lakes Territory Hotel Statler.

June 14-16—NATIONAL FIRE PROTECTION ASSOCIATION. Annual meeting. San Francisco.

June 15-17 LEAGUE OF MICHIGAN MUNICIPALITIES Annual Convention. Kalamazoo, Mich.

June 17—PHILADELPHIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Outing at Howard Memorial Field

June 17 INLAND EMPIRE SECTION AMERICAN SOCIETY OF MECHANICAL ENGINEERS Joint meeting with engineering societies of Spokane

June 20-24—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS 14th semi-annual meeting. Detroit Mich.

June 20-24 AMERICAN SOCIETY FOR TESTING MATERIALS Annual meeting Asbury Park N. J.

June 28—ATLANTA Secretary AMERICAN SOCIETY OF MECHANICAL ENGINEERS Election of officers Georgia School of Technology, Atlanta

June 28-July 1 SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION UNIVERSITY OF PITTSBURG Annual convention New Haven Conn

July 15—NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS Annual meeting Crown Hotel, Providence, R. I.

Aug. 10-12—INTERNATIONAL ASSOCIATION OF STREET CLEANING OFFICIALS. Annual conference Hotel La Salle, Chicago, Ill.

Sept. 28 (10 days) NEW YORK ELECTRICAL EXPOSITION Seventy-first Regiment Armory, New York City.

Oct. 11-14—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS Annual Convention, Atlanta Ga. Hotel Ansley Secretary, James J. Mulcahey, Municipal Building, Denver, Colo.

Oct. 24-28—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS Annual convention, Southern Hotel, Baltimore Md Secretary Charles Carroll Brown Valparaiso Ind

Nov 14-18 AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

AMERICAN SOCIETY OF CIVIL ENGINEERS

The annual convention of the American Society of Civil Engineers was held at Houston, Texas, on April 27, with 140 members in attendance. The net result of the business session was the unanimous acceptance of the constitutional amendments presented by the committee on referred amendments. Several minor changes were made, with which exception the committee draft stands.

No other business was considered, but the following announcements were made: That the publication of papers and discussions in the "Proceedings" would be resumed; that a committee be authorized to promote the technical interest and activities of the society; and that a research committee be authorized to stimulate research work.

Addresses were delivered by J. H. Brillhart, Gov. P. M. Neff, Mayor O. T. Holcomb and E. E. Sands; followed by the presidential address by Mr. Webster on the subject of "The Municipal Engineer." The constitution was next discussed by various members and minor changes accepted.

It was announced that Elbert M. Chandler, of Olympia, Wash., chief engineer of the Washington State Reclamation Service, had been appointed acting secretary of the society.

AMERICAN ASSOCIATION OF ENGINEERS

The annual meeting of the American Association of Engineers at Buffalo, May 9 to 11, endorsed the following national activities of engineers:

1. Favoring an engineer on the International Boundary Commission.

2. Favoring a national board of classification for engineering schools.

3. Against laws permitting corporations to practice as engineers.

4. Favoring a census of highway traffic.

5. Favoring a continuance of Federal aid to highways.

6. Favoring Phipps bill increasing Federal Aid allotment in public land estates.

7. Favoring national financing of reclamation work.

8. Favoring sanitary engineers on public board of health.

9. Directing advance copies of annual convention reports be prepared.

10. Favoring a minimum of two weeks' notice by both parties in case of separations in employment.

11. Providing for committee to plan employment service and payment therefor.

12. Favoring increasing the membership from all classes of engineers.

13. Providing a committee to amplify statement of the ideals and objects of the association.

14. Thanking the city of Buffalo and the Buffalo Chapter for the courtesies extended to the convention.

The officers elected for the ensuing year were H. O. Garmon, chief engineer and consulting engineer with the Indiana Public Utilities Commission, president of the association; A. N. Johnson, dean of engineering at Maryland State College, vice-president; A. S. Morris, auditor, capital expenditures, C. & N. W. R. R., second vice-president; F. F. Ayres, Webster L. Benham, Garrison Babcock, Morris Bien, G. M. Butler and W. R. McKeen were elected directors. C. A. Hoglund, C. D. [illegible], auditing [illegible].

The most important dev[illegible] the convention was the [illegible] gram for activities [illegible] the association scattered th[illegible] country, based upon the [illegible] ities of these chapters during the year, along the lines of [illegible] civic activities, legislation, [illegible] cation and compensation.

During the past twelve months the Employment Bureau at the [illegible] was instrumental in placing [illegible] in positions. The employment [illegible] of the association is maintained as a free service to its members.

Salt Lake City was selected as the convention city for next year.

The program of the meeting consisted of hearing reports of various national committees, including those on various employment, railroad, industrial, federal, salaries of engineers in public service and in teaching service, water power and conservation, highways and the numerous other activities of the organization.

On the afternoon of the second day a trip was made to Niagara Falls by 130 delegates.

At the banquet on May 10 addresses were delivered by L. K. Sherman, H. O. Garmon and Frances A. Kellar, who spoke on "Americanization and Man Power."

An interesting feature of the convention was the St. Lawrence Waterway, which was discussed by Senator Henry W. Hill, of the New York State, and Dr. F. H. Newell, former director of Reclamation service.

SOUTHWEST WATER WORKS ASSOCIATION

The tenth annual convention was held at the Skirvin Hotel, Oklahoma City, Okla., May 9, 10, 11, 12, 1921. The program included papers on "Sanitary Control of Public Water Supplies," by M. Z. Blair; "Overhauling a Neglected Distribution System," by A. S. Holway; "Rules and Regulations," by W. A. Stanfield; "Surface Water in Oklahoma," by A. R. Lewis; "Water Collections," Miss Adella Martin; Discussion; "Water Works Reports and What They Should Contain," by R. E. McDonnell; "State Supervision of Water Supplies," by V. M. Ehlers; Round Table Discussions, by Superintendents. Open house at Sherman Machine & Iron Works. "How to Get Out Water Bills Promptly," by H. A. Gallagher; "Today's Greatest Needs Essential to Successful Operation," by J. F. Christy. Election of officers and routine business, entertainments for ladies, a dance, reception, banquet, trip to El Reno to inspect the city water works.

CONFERENCE OF STATE SANITARY ENGINEERS

A meeting will be held June 1 and 2 at the Hotel Bellevue, Boston. There will be papers on "Some Productive Activities of a State Sanitary Engineering Office," by Robert B. Morse. "The Typhoid Epidemic at Salem, Ohio," by W. H. Dittoe. "State Sanitation," by Geo. C. Whipple. "The Certification and Supervision of Water Supplies on Interstate Carriers." "Water-borne Epidemics Among Passengers and Crews of Vessels," by J. I. Connolly. "The Policy of the Public Health Service for the Supervision of Water Supplies of

Common Carriers," by I. W. Mendelsohn. "Experiences with the Supervision of Water Supplies on Vessels Plying on the Great Lakes," by A. E. Gorman. "The Co-operation of the State Health Departments in the Certification of Interstate Water Supplies," by E. S. Tisdale. "Supervision of Milk Pasteurization in Minnesota," by H. A. Whittaker. "State Control of Stream Pollution and Sewage Disposal in Connecticut," by J. F. Jackson. "Mosquito Control Work in Arkansas," by M. Z. Bair. "Ratproofing from an Engineer's Point of View," by A. F. Allen.

Reports will be received from committees on water supply, cross connections and by-passes on water supplies, laws, organization, policy and procedure, milk supply, stream pollution and sewage disposal, mosquito control, and on swimming pools.

WESTERN SOCIETY OF ENGINEERS

At the meeting on May 4, the Western Society of Engineers elected the following officers: President, Charles H. MacDowell; first vice-president, Julius L. Hecht; second vice-president, F. F. Fowler; third vice-president, Benjamin S. Shapiro; treasurer, Homer E. Niess; trustee, Edwin W. Allen; and members of the Washington Award Commission, John F. Hayford and Henry J. Burt.

AMERICAN SOCIETY OF SAFETY ENGINEERS

The American Society of Safety Engineers has made application for charter membership in the Federated American Engineering Societies.

NEW YORK SECTION AMERICAN SOCIETY OF CIVIL ENGINEERS

At the regular meeting, May 11, "Bridges and Tunnels in the Metropolitan District" were discussed. Professor William H. Burr, consulting engineer, introduced the subject and J. Vipond Davies, C. M. Holland, chief engineer, New York and New Jersey Bridge and Tunnel Commissions, Gustav Lindenthal, Ralph Modjeski, J. F. O'Rourke and J. A. L. Waddell participated in the discussion.

PERSONALS

Ripley, Theron M., of Watertown, N. Y., former division engineer at Hornell, N. Y., has been reinstated by Commissioner Sisson. To make room for him, Perry Filkin has been transferred to the Buffalo division office; and Squire E. Fitch, who has been serving as division engineer in Buffalo, will return to his former position as superintendent of maintenance covering the western half of the state.

Reed, William B., of Weedsport, has been appointed third deputy to Highway Commissioner Herbert S. Sisson.

Moloy, Robert J., who has been with the New York State Highway Commission for the past two years, has resigned his position and will take up his new duty as examiner in the New York office of the State Insurance Department.

Benedict, B. W., has resigned as city engineer of Lockport, N. Y.

Shulde, H. G., has been appointed district engineer of the Pennsylvania State Highway Department with headquarters at Bedford.

Myers, Clarence B., has resigned from the Pennsylvania State Highway Department to become assistant engineer in the Philadelphia Bureau of Highways.

Corwin, J. O., Jr., has been appointed engineer of Travis county, Texas.

Smithley, Charles, has been appointed county engineer of Geary county, Kan.

Rhodes, A. T., formerly street commissioner of Worcester, Mass., was recently appointed representative of the Austin-Western Road Machinery Co. in the New England district.

Harris, A. L., has just been appointed municipal architect for the city of Washington, D. C.

Marden, Charles, of Detroit, Mich., was again elected village engineer of Grosse Point, Park, Mich., at a recent election.

McLean, J. C., has been appointed county engineer at Woodbury county, La.

Michel, B. G., has resigned as city engineer of Kitchener, Ont., in order to enter business as road contractor.

Robertson, Peter, of Beansville, Ont., has resigned as road superintendent of Lincoln, county, Ont. His position will be filled by Frank N. Rutherford, of St. Catherines, Ont.

Lanctot, Theodore, of Montreal, has been appointed city engineer of Hull, Quebec.

Jepson, W. C., was recently appointed city engineer of Niagara Falls, Ont.

Caldwell, R. E., of Caldwell & Richards, civil engineers of Salt Lake City, Utah, has been appointed state engineer of Utah by Governor Charles R. Mabey.

Hommon, H. B., of the United States Public Health Service, has been appointed head of the sanitation work in United States National Parks with headquarters in San Francisco. Charles Gilman Hyde has been named as consultant in connection with this work.

Worley, J. E., has been appointed chief engineer of the Kansas Public Utilities Commission with headquarters in Topeka, Kan.

Rhodes, A. J., has been appointed city engineer of Manhattan, Kan.

Chambers, John, city engineer of Louisville, Ky., has been appointed chief engineer and superintendent of the Louisville Water Co.

Hewett, F. R., has resigned as county construction engineer of Adams county, Washington, to accept a position with the Washington State Highway Department. His former position has been filled by G. C. Sturman.

Dix, Thurman W., has been appointed state highway commission of Vermont.

Tuttle, William C., has been appointed superintendent of highways and water works of Attleboro, Mass.

Walker, Thomas H., chief inspector of the engineering department of the Kansas City Water Works Department, died in Kansas City on March 20.

Mead, Thomas, formerly deputy engineer, has been appointed county engineer for Whitman county, Wash.

Terrell, R. C., has resigned as state highway engineer of Oklahoma, and B. F. Clark appointed to his position.

Fredenhagen, V. B., has been appointed county engineer of Fewell county, Kan.

Rice, C. E., has been appointed city engineer of Wooster, Ohio.

Freeman, B. C., has been appointed resident engineer of pavement projects and roads for the state highway department in Sanilac county.

Larson, W. H. formerly county highway superintendent of Union county, South Dakota, has been appointed county highway superintendent of Hughes county. His former position will be filled by L. J. Johnson, of Elk Point.

Naylor, Perry T., formerly assistant city engineer of Hastings, Neb., has been appointed city engineer.

Brownell, James P., civil engineer with offices in Carthage, N. Y., has been appointed city engineer of that city.

Peck, Frank S., formerly state highway engineer of South Dakota, has been appointed highway engineer of Minnehaha county, South Dakota.

Mitchell, A. F., acting district engineer of the Dominion Department of Public Works, Victoria, B. C., has been appointed senior assistant engineer.

Doncaster, P. E., senior assistant engineer of the Dominion Department of Public Works, at Westminster, B. C., has been transferred to Nelson to succeed J. P. Forde, who will be in charge at Victoria.

Shupe, Stanley, town engineer of Oshawa, has resigned to become city engineer of Kitchener to succeed G. B. Michel, who recently resigned.

Lazinby, Paul A., has been appointed engineer to the newly organized Toronto Transportation Commission, Toronto, Can.

Feiker, F. M., vice-president of the McGraw-Hill publications, has been appointed personal assistant to Herbert Hoover, Secretary of the United States Department of Commerce.

French, L. G., for thirteen years assistant secretary of the American Society of Mechanical Engineers, died April 18. He was editor and manager of *The Mechanical Engineer*, and also author of several books on mechanical engineering, including the earliest American treatise on the steam turbine.

T. L. SMITH

Mr. Thomas L. Smith, founder, director and chief stockholder of the T. L. Smith Company, died Friday, April 29, 1921, at his home in Milwaukee. The early part of his career, immediately following his college life, was spent in drafting and engineering work with some of Milwaukee's large manufacturers. His interest in concrete mixers developed in 1898 and 1899 when he was conducting a school of engineering and mechanical drawing in Milwaukee, and the first machine was manufactured in 1900 and gave ten years of hard service. In 1905 Mr. Smith organized the T. L. Smith Company, which today has assets of over $1,200,000.

The T. L. Smith Company represents only one of Mr. T. L. Smith's successful business ventures. Mr. Smith purchased a controlling interest in the Sterling Wheelbarrow Co., West Allis, Wis. He also organized and developed the Smith Engineering Works, Milwaukee, manufacturers of Telsmith rock and ore crushers.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

SPECIALTY LOADERS

The Specialty Engineering Company, designers of the first portable wagon loader of the chain and bucket type, makes a number of portable loading machines suitable for handling sand, gravel, broken stone, coal and other materials.

The No. 15 wagon loader, 11 feet 6 inches high, is mounted on 48-inch wheels and has 16 x 9-inch malleable iron buckets, a hopper 24 inches wide, back chute with gate and 24 x 48-inch screen with three sizes of mesh and a plain steel plate. The bucket chains are double, the bearings are of the bronze ball and socket type, and the machine is operated with a 3 h. p. motor in a dust-proof casing and has a capacity to screen and load 1 ton in less than 2 minutes.

A similar machine having a height of 9 feet has been designed for hard continuous service, weighs about 4,400 pounds and will load 1 ton of sand or stone per minute. It has no screens.

A portable machine of the belt type is provided with side plates forming a wide trough enabling it to carry a large quantity of bituminous coal or other material. The three-ply rubber belt is reinforced on the conveying surface and travels on steel tube pulleys with self-lubricating bearings. It has a screw take-up adjustment and is light, strong and efficient.

In another type of conveyor made by the same manufacturers the belt travels on troughing rollers, giving it a greater capacity, and is supported on a trussed framework of structural steel suspended near the center of gravity by a chain hoist that enables it to be set at any required elevation and inclination. It is useful for unloading cars, filling high storage piles, filling stock bins or loading wagons or trucks. It is made in lengths of 25 to 60 feet on centers with vertical heights up to 23 feet, and horizontal reach of 58 feet and weighs up to 16,000 pounds.

TEC TRUCKS

Tec trucks, manufactured by the Terminal Engineering Company, Incorporated, are sturdy, powerful, compact, small-size trucks designed for duty on highways, in buildings, yards and especially for terminal service and for handling large quantities of merchandise rapidly and continuously for short distances, as in loading, unloading, transferring and storing.

Special provision for continuity of service and the elimination of waiting time is provided by the supplementary loading platforms that can be almost instantly transferred to and from the truck by the truck itself, enabling the latter to be constantly in motion while the cargoes are being loaded and unloaded without loss of time.

This is accomplished by making the truck with a low, narrow platform with clearance enabling it to be quickly inserted under the loading platform, which is then transferred to it and carried with its load. The loading platform is of heavy steel and wood construction with or without rollers.

The truck is equipped with five electric motors separately driving its four carrying and steering wheels and its lifting jacks. It has a 47½ x 122-inch platform 24 inches high, four independent rubber tired wheels built with roller bearings, a 60-volt 24-cell battery good for 24 hours' continuous operation, a capacity of 5,000 pounds and a speed of ½ mile to 10 miles per hour.

It has a drum controller, automatic coupler, and efficient brakes and springs. It is provided with electric lights and horn and has elevating loading and unloading jacks with 9½-inch travel. Among the numerous special uses for which it is recommended are the transportation of dumping buckets, elevating loaders, derricks, concrete mixers, air compressors, fire apparatus, etc.

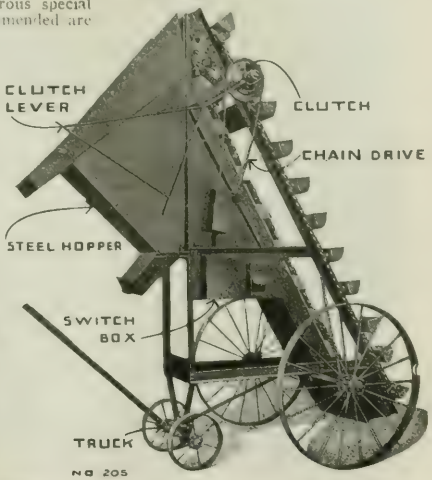
ARCADIA TRAILERS FOR MOTOR TRUCKS

The Arcadia Body Corp. and the Arcadia Trailer Corp., both of Newark, N. Y., issue circulars illustrating many different types of truck and trailer bodies with open and closed tops, racks, platforms and dumping apparatus and with these combined. They also show the principal details and structural features of the Arcadia trailers and reversible trailers which are made in 2, 3, 4 and 5-ton sizes with capacities of 113 to 150 cubic feet and weights of from 1,500 to 5,000 pounds. The trailers are provided with special drawbar attachments so that one or more trailers attached to a truck will follow exactly in the path of the latter without any attention.

ROGERS ALL STEEL TRAILERS

All-steel trailers manufactured by the Rogers Brothers Company are made in 2-wheel and 4-wheel types with various special features. They are made in 2, 3, 5, 7½ and 10-ton sizes with 4-wheel reversible short-turn gear type and in the same sizes of 4-wheel non-reversible type. The 2-wheel semi-dump type are made in 3, 5 and 7½-ton sizes, as is the semi-trailer. There are logging trailers with a capacity of 1, 3, 5, 7½ and 10 tons on the axle and dump trailers of 2, 2½ and 3-ton capacity. The model FD trailer has a special platform frame with clearance at the rear for the dump body to revolve downward through and clear of it till the lower end nearly or quite touches the ground.

BELT TYPE LOADER WITH SIDE PLATES



BUCKET LOADER WITH HOPPER AND BACK CHUTE

STEEL BODIES FOR GARBAGE COLLECTION

The city of Madison, Wis., has placed in service several Winther chasses fitted with garbage bodies and hydraulic hoists for dumping them that were manufactured by the Heil Co., Milwaukee, Wis.

These particular bodies have six covers. The front four open at the sides and the rear two open at the back. Adjustable steps on either side of the body and at the rear make it easy to load the body. The bodies are thoroughly welded by the electric process so that no liquid garbage can drip on the street. The tail gate is hinged at the top so that it swings outward when released. It is held tightly in place with four wing nuts. Between the tail gate and the body rubber packing is placed to keep it tight. If bodies are desired without covers, loops are provided on the sides so that a canvas cover can be tied over. It frequently happens that bodies are made with a taper at the rear end, i.. which case the tail gate is not necessary, as the bottom of the body tapers or slopes up to the top.

All Heil Co. bodies are made 3 inches wider at the rear than at the front, so that the load will slide out freely. All rivets are countersunk and there is nothing to obstruct the flow of material whenever the body is elevated.

The Hydro hoist is particularly adapted for this kind of work as it is mounted under the body, thus permitting all the loading space to be utilized. This makes it possible for a longer body to be used than if the hoist was placed just back of the cab. These bodies and hoists are designed to be mounted on any make or model of truck. They are neat, durable and sanitary and avoid nuisance in transporting offensive materials.

Cities which do not wish to buy expensive equipment can purchase light trucks and install on them gravity bodies. These bodies are considerably higher because of their design; nevertheless are of great advantage because they can be easily dumped. Moreover, the cost is very slight as a one and one-half yard body costs only $120 plus the war tax.

GARBAGE BODY WITH SECTIONAL COVER

INDUSTRIAL NOTES

D. Henry Bonner, who recently resigned from the Ford Motor Company, has joined the Four-Wheel Drive Auto Co., in the capacity of sales manager.

Sauerman Bros., of Chicago, have arranged with Mr. S. D. LeClair, of San Francisco, to take over the manufacturing and selling rights of his power drag scraper. This gives Sauerman Bros. four different types of scrapers; the "Crescent," "Type C," "Excavator" and "LeClair," all of which are bottomless and thus require no power or mechanism for dumping.

The Equipment Corporation of America is to erect a large plant for the rebuilding of heavy contractors' equipment at Maywood, Ind. Their present plant at Chicago will be continued to rebuild hoisting engines, concrete mixers, pumps ad similar small equipment. This will give the Equipment Corporation five plants in all.

The Badger Meter Manufacturing Company, of Milwaukee, Wis., has opened a district sales and service office in Kansas City, Mo., which office will be in charge of Charles Stotler, western sales manager. This company will be represented in Arkansas and Oklahoma by Charles Barry, and in Texas and Louisiana by Luke L. Ballard.

The Warren Bituminous Paving Co., of Ontario, has removed its business offices to Toronto.

William S. Turner & Co., Portland, Ore., has been organized as manufacturers' agents for the sale of equipment for electric railways, lighting and power systems, pumping and industrial plants, to make investigations and reports; and to design and construct public utility, municipal and manufacturing works.

The Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa., has opened an office in Detroit, in charge of M. P. Cogswell, to handle the Michigan and northwestern Ohio territory.

The Hallidie Machinery Co., of Seattle, Wash., has been appointed representative of the Conveyors Corporation of America, Chicago, to handle the sale of the American steam conveyor and the American trolley carrier in Washington and Oregon.

The American Engineering Co., of Philadelphia, Pa., manufacturers of the Taylor stoker, has established a midwestern service station at Detroit, Mich., which branch will carry a complete stock of parts for all types and sizes of Taylor stokers.

The Byers Machine Co., of Ravenna, Ohio, has opened direct sales offices for its cranes and hoists, one at New York under F. W. S. Elmes, district manager, and one at St. Louis, with Frank E. Miner as district manager.

Homer J. Forsythe, manager on the construction division of the engineering department of the Du Pont Company, has been transferred to the position of assistant general manager of the Hyatt Roller Bearing Company, of Newark, N. J.

The Western Wood Pipe Publicity Bureau has opened an office at 775-777 Monadnock building, San Francisco, Cal., in order to follow more closely the irrigation, water supply and other hydraulic developments of that section of the country, and to provide closer contact with the California companies it serves.

The contractors' equipment line of the Clyde Iron Works Sales Co., of Duluth, Minn., has recently been placed with Edelen & Co., Philadelphia, the Queen City Supply Co., of Cincinnati, and Waldo Bros. & Bond Co., of Boston. The sales territory of this latter company will comprise all of the New England states.

The Engineering Business Exchange has just opened a southwestern branch at Washington, D. C., with Marshall O. Leighton, consulting enginer, as director. This branch will have especial charge of the territory from Maryland to Alabama, inclusive.

INFORMATION BUREAU FOR NEW YORK STATE CONTRACTORS

In order to supply complete information to contractors for all New York State departments, the American Surety Company of New York has opened a State Surety Bond Bureau at 148 State street, Albany. The service of this bureau will be to furnish without cost to its clients accurate contract news from every department as soon as the information is made available to the public.

The State Surety Bond Bureau will be under the direction of Farrington Smith, who has had long experience in the insurance and surety fields. The work will be comprehensive, covering not only construction work but also supplies of every kind. Some of the services of the bureau will be: Daily bulletins containing notices of all state calls for bids on purchases, sales and construction work; the furnishing of bidding blanks and specifications to all contractors interested; telegraphic notice of bid openings and awards; filing of bid papers; reporting of bid openings, with prices.

While a few of the state departments have for periods sent calls for bids to contractors, there has been no way of getting information from all departments except at considerable expense in keeping a representative in Albany. The State Surety Bond Bureau will in effect act as Albany representative for its client contractors, serving them in every possible way.

The office of the bureau will be entirely distinct from the Albany branch of the American Surety Company, which solicits and executes surety bonds of all kinds, including public official and depository bonds and which is located at 100 State street.

ROAD BUILDING EQUIPMENT

The new Materials Handling Division of the American Society of Mechanical Engineers reserved sessions for the discussion of "Design and Construction of Machinery for Road Building" at the society's spring meeting which was held at Congress Hotel, Chicago, May 23-26. Four papers treated this problem from the viewpoint of the contractor, the road builder, and possible future development of mechanical equipment in road building.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Municipal Journal and Engineer, Inc.
Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879

Vol. 50 JUNE 4, 1921 No. 23

World's Longest Tunnel for New York's Water Supply

A tunnel more than eighteen miles long under the Catskill mountains, is being built by the largest city in the country to supply itself with the largest amount of the best water. The engineers in charge probably constitute the largest, oldest and finest organization of its kind.

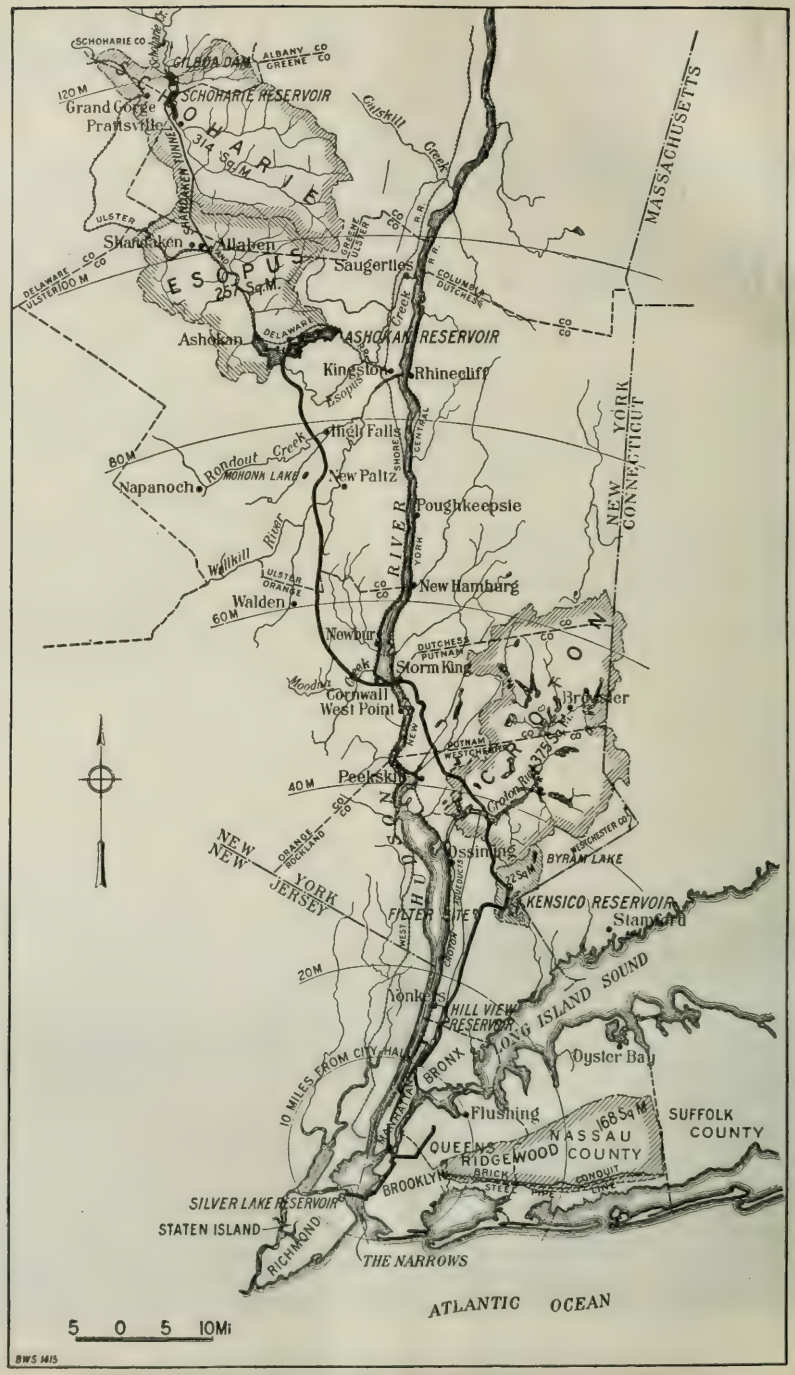
The Board of Water Supply of New York City has begun construction on the longest tunnel so far built for any purpose whatever. This tunnel is also remarkable because of its purpose, which is to compel Schoharie creek, which now flows northward into the Mohawk river, to reverse its direction of flow and discharge its waters into the Ashokan reservoir, miles to the south of its source.

The Catskill mountains form a summit in the topography of eastern New York, from which streams flow to the south and east into the Hudson, to the north into the Mohawk and to the west into the Delaware river.

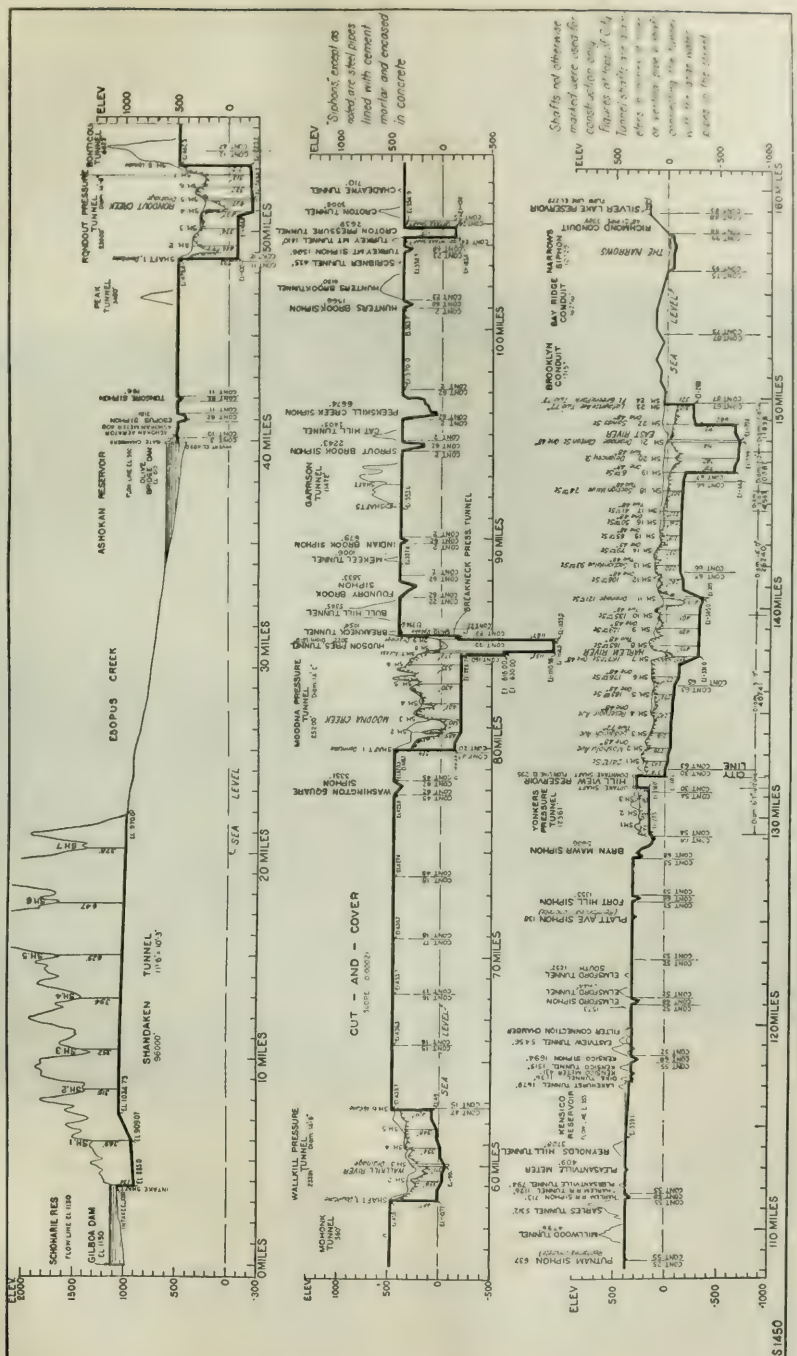
In selecting a watershed in the Catskills for New York's water supply which would at once provide abundant head and a safe and economical location for a reservoir, the Esopus creek was chosen as the first development, and the Ashokan dam was built on this creek, from which a supply is brought by gravity through the 92 miles of the Catskill aqueduct to the city's northern boundary. The Esopus flows south and east into the Hudson and the natural topography of the land therefore favored this scheme.

The supply from the Esopus, however, will be insufficient for many more years of the city's growth. In fact, the city for the past four years

VIEW OF SHAFT NO. 1, LOOKING NORTH
THE STRUCTURES FROM LEFT TO RIGHT ARE AS FOLLOWS: HEAD-FRAME OVER SHAFT; COMPRESSOR HOUSE; HOIST HOUSE; SWITCH HOUSE AND TRANSFORMERS AT THE EXTREME RIGHT



MAP OF CROTON AND CATSKILL WATERSHEDS AND AQUEDUCTS



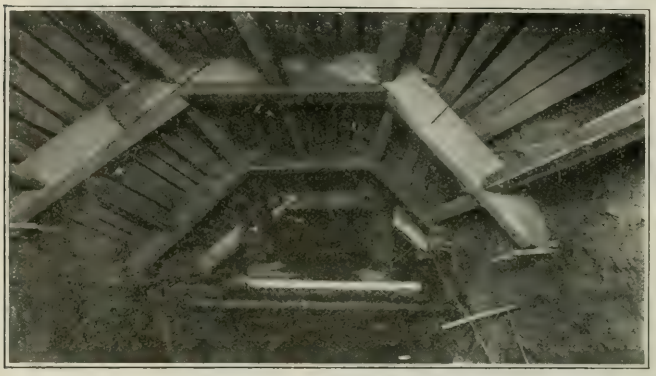
PROFILE OF SHANDAKEN TUNNEL AND CATSKILL AQUEDUCT, WITH RESERVOIRS

has been using more than the safe yield from this watershed. Under this heavy draft the Ashokan reservoir has on several occasions been greatly depleted, although, owing to the unusually heavy rainfall of the past spring, it was on May 18 within four feet of the overflow. It should be said, however, that water is being wasted from the Croton supply (which formerly furnished New York with most of its water) and that the combined Catskill and Croton supplies will suffice for several years to come. (The Croton supply is being wasted in preference to wasting from the Catskill supply because of the more favorable head of the latter and also because of the rainfall conditions that have prevailed for the past 18 months. Within comparatively few years, however, these combined supplies will fail to be sufficient for the population of the city, which is increasing at the average rate of more than 150,000 persons a year or about 20,000,000 gallons a day, and it is therefore imperative that an additional supply be provided. For the past five years the consumption of water has been increasing at the average annual rate of 32,000,000 gallons daily.

In order to obtain this additional supply, the Board of Water Supply is preparing to secure water from the Schoharie creek. This creek flows away from the city, with high mountain peaks of the Shandaken range between it and the Esopus watershed and the Catskill aqueduct into which the Schoharie water is to be lead. The leading of the water from the north side of the Shandaken range to the south side presented only two alternatives, that of pumping water over the range, or carrying it under the range in tunnel. There could be no question as to which was both the safest and the most economical in ultimate cost, and a tunnel is now being constructed under the Shandaken range for bringing Schoharie water into Esopus creek. The Schoharie water will be discharged into the creek several miles above the Ashokan dam and will flow down the bed of the creek into the Ashokan reservoir.

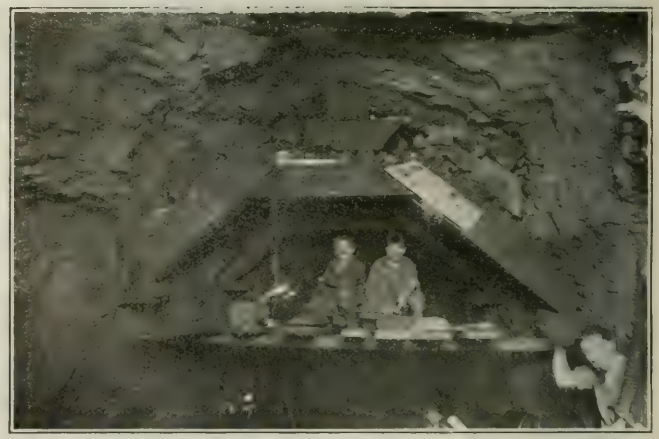
This reservoir was originally designed and constructed with capacity sufficient to store the waters of the Schoharie as well as of the Esopus, and the aqueduct was also designed with capacity for carrying the combined yield.

One of the questions interesting fishermen on the engineering corps of the water board is pre-



THESE TWO VIEWS GIVE A GOOD IDEA OF THE TUNNEL. THE UPPER ONE SHOWS THE TIMBER BENTS AND LAGGING RESTING UPON THEM. THIS TIMBERING IS KEPT UP CLOSE TO THE HEADING. THE MEN SEEN IN THE BACKGROUND ARE PLACING DRY PACKING ABOVE HE LAGGING. BEYOND THEM ARE MEN DRILLING THE TOP BENCH. A BOTTOM HEADING WAS THEN BEING CARRIED 35 FEET IN ADVANCE OF THE TOP BENCH.

IN THE FOREGROUND ARE SHOWN THE 1 1-4 INCH SQUARE IRON PINS ON WHICH THE TIMBERS REST.



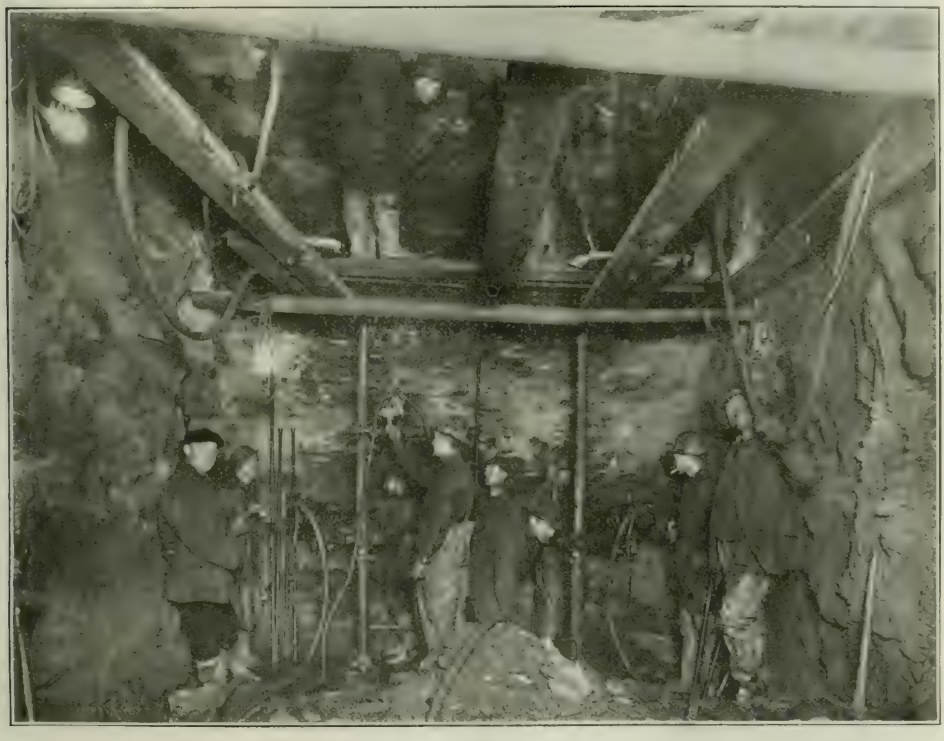
IN THE LOWER VIEW IS SHOWN AN END VIEW OF THE TIMBERING TAKEN FROM THE MUCK PILE. THE MEN SHOWN ARE PLACING DRY PACKING ABOVE THE TIMBERING, WHICH IS ABOUT 15 FEET FROM THE FACE OF THE TOP BENCH.

THIS TIMBERING IS ENTIRELY OUTSIDE THE LIMIT OF THE TUNNEL LINING AND WILL BE LEFT IN PERMANENTLY. IT HAS NOT YET BEEN DECIDED WHETHER OR NOT THE DRY PACKING WILL BE GROUTED AFTER THE COMPLETION OF THE LINING.

sented by the fact that, while the Esopus is a famous trout stream, the Schoharie is well stocked with bass and it is to be expected that these bass will travel through the tunnel and find their way into the Esopus creek.

The tunnel under the Shandaken range is known as the Shandaken tunnel. As originally planned by the Burr-Hering-Freeman report, this tunnel would have been about 10 miles long. In endeavoring to find a suitable site for a dam across the Schoharie, successive positions from point to point down the Schoharie creek were investigated until finally one was located at Gilboa, about 8 miles below the original tentative location. This increases the length of tunnel to something over 18 miles—95,530 feet—thus, of course, adding considerably to the cost. In compensation, however, it considerably increases the area of watershed above the dam and consequently the amount of water which can be obtained. The dam now under construction at Gilboa is known as the Gilboa dam. The area of watershed above the dam is 314 square miles, which is 57 miles greater than that of the Esopus shed, tributary to the Ashokan reservoir.

These two features, the Gilboa dam and the Schoharie tunnel, constitute practically the whole of the Schoharie development. The basin of the Schoharie reservoir does not rise to any [illegible] or low places requiring dikes to prevent the escape of the water, as does the Ashokan reservoir. The reservoir will have a total storage of only 22,000,000,000 gallons and will be used mainly as a diversion reservoir and an equalizing reservoir for temporary storage of flood waters than for long-time storage of the water, the latter service being performed by the Ashokan reservoir. The Schoharie reservoir will therefore ordinarily contain only a small proportion of its 22,000,000,000 gallons capacity, the Schoharie water flowing continuously through the Shandaken tunnel into the Ashokan reservoir.



TUNNEL HEADING SOUTH OF SHAFT NO. 6

DRILLING IN THE SOUTH TUNNEL. THE ENTIRE SECTION IS DRILLED HERE AT ONE TIME, USING FIVE "WATER LEYNER" DRILLS MOUNTED ON TWO VERTICAL COLUMNS

Construction upon the Gilboa dam is well under way, and that of the Shandaken tunnel has progressed to a total excavation of approximately five miles. The construction of the dam will be described in a later article. The present will be confined to work upon the tunnel.

THE SHANDAKEN TUNNEL

The hydraulic gradient of the tunnel falls 4.0 feet per mile, and the tunnel follows this through the greater part of its length. In order, however, to keep it throughout in solid ledge rock, the first 18,000 feet is below the gradient and consequent-

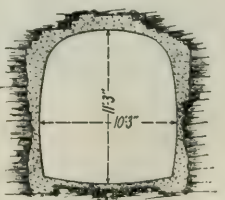
IN THE NORTH TUNNEL AT SHAFT NO. 6. "MYERS-WHALEY NO. 4" TYPE MUCKING MACHINE READY FOR OPERATION BY A 20-HORSEPOWER, 220-VOLT, 60-CYCLE, 49-AMPERE, CONTINUOUS MOTOR. THE MUCKING MACHINE CONSISTS OF A SMALL SHOVEL WHICH THROWS THE MUCK ONTO AN ENDLESS BELT CARRYING IT TO THE REAR WHERE IT FALLS INTO THE MUCK CARS. IT IS POSSIBLE WITH THIS MACHINE TO LOAD A 1 1-2 CUBIC YARD CAR IN ABOUT TWO MINUTES. THE MOTOR IS UNDER THE ENDLESS BELT. THE VIEW IS TAKEN FROM THE TOP OF THE MUCK PILE.

ly under pressure. More than 150 borings were taken along the proposed line of the tunnel to determine the nature and depth of the rock below the ground surface. They showed the rock to be of sandstone and shale throughout the entire route of the tunnel, and in most places for several hundred feet above the tunnel gradient. Near the north end, however, the borings revealed a pre-glacial gorge crossing the line, and the drop in the tunnel grade referred to was made to provide a roof of solid rock above the tunnel, which roof is at least 70 or 80 feet thick at the lowest point of the gorge. This drop brings the tunnel about 135 feet below the hydraulic gradient.

Near the south end the tunnel dips so as to bring its roof slightly below the hydraulic gradient, forming a "running trap"; the object being to cut off access to the tunnel from the end and to prevent wind blowing into it.

The rock strata throughout the entire length of the tunnel are apparently continuous, and dip downward toward the south at an angle of approximately 5 degrees with the horizontal, measured along the line of the tunnel.

The gravity section of the tunnel is approximately horseshoe shape with a maximum horizontal diameter of 10 feet 3 inches and a maximum vertical diameter of 11 feet 6 inches. Where below hydraulic gradient the shape of the tunnel is slightly modified by rounding the lower corners, producing a section considered to be a little stronger to resist internal pressure. On account of the horizontal stratification of the rock, the roof is made flatter than is generally found in horseshoe sections. The capacity of the tunnel is calculated at 600,000,000 gallons a day with a velocity of flow of 8.7 feet per second or 5.9 miles per hour.



CROSS SECTION OF SHANDAKEN TUNNEL.

The alignment of the tunnel is not straight, but winds somewhat from a bee-line in order to take advantage of favorable notches in the hills for the location of shafts. There are seven shafts along the line of the tunnel, a portal at the south end, and an intake shaft at the north end about mid-length of the Schoharie reservoir. These shafts vary in depth from 320 feet in shaft No. 2 to 630 feet in shaft No. 5, except that the intake shaft has a depth of only 175 feet.

The shafts all have permanent lining and will be covered with a stone head house. This will furnish access to the tunnel at intervals of 1½ to 2¾ miles, for inspection or repair. At the intake shaft will be a head house nearly 200 feet long, containing the residence of the keeper and appliances for operating the screens, and the valves controlling the intake openings, which are located to draw from two levels.

As a result of studies in economical working based on progress actually obtained and on the requirements as to the time of the completion of the entire tunnel, the contractor is not working the tunnel from shaft No. 2, but plans to connect between shafts No. 1 and No. 3; unless delays in tunneling should make it necessary to increase the number of headings in order to complete the work within the time limit. He also decided not to work the tunnel from the south portal, but to complete the south end of the tunnel from shaft No. 7.

CONSTRUCTION METHODS

The contract for the entire tunnel was awarded to the Degnon Contracting Company, but last November this company assigned the work to the Shandaken Tunnel Corporation, which is now carrying it on. The contractor has approximately $1,000,000 invested in plant for this work, located chiefly at the shafts and in the tunnel. The rock and other conditions, except depth of shaft, being practically the same throughout the work, both plant and methods are practically the same at each shaft and heading, except for shaft No. 6, which will be referred to later.

The total depth of the seven shafts is 3,238 feet. The shafts are lined with concrete and are 14 feet in diameter. The excavation required removing about 8 cubic yards of rock per vertical foot, or a total of 27,600 cubic yards for all the shafts. The shaft sinking was done by the S. J. Harry Company.

The theoretical excavation for the tunnel is 5.7 cubic yards per linear foot, or a total of 565,000 cubic yards. However, where the engineers decide to place permanent roof timbering above the lining, the excavation is increased to approximately 7 cubic yards per linear foot.

The rock in the tunnel has not, in general stood up as well as was expected and it now seems probable that about 30 per cent will require timbering. The rock breaks well to line so that there is little unnecessary material removed beyond the designated excavation limits.

Work has progressed over one mile north from shaft No. 1 and to varying distances from the other five shafts, the tunnel not being worked at all from shaft No. 2, as before stated.

In all except shafts No. 4 and No. 6 the tunneling is done by top heading and [illegible] at shaft No. 4 the bottom heading and two benches enlarge is being employed. The rock is sufficiently [illegible] that it is not probable that any lining will be [illegible] until after the entire completion of work at a [illegible] In the ground that does not require support [illegible] ress is at the rate of about 14 feet a day at [illegible] heading. In general, 10 line holes are drilled and 8 relief holes, all 8 feet deep, and 6 cut holes, all 9 feet deep. The holes are fired at 7 in the morning and 5 or 6 in the evening, the work being carried on in two shifts a day.

The work is under the immediate charge of George G. Honness as department engineer, J. Waldo Smith being chief engineer of the Board of Water Supply and Thaddeus Merriman deputy chief engineer. The work is divided into three sections, each in charge of a division engineer. The Allaben or southern division is in charge of Chas. M. Clarke; Wm. B. Hunter is in charge of the Prattsville or northern division of the tunnel, and James A. Guttridge is division engineer of the Gilboa division.

(To Be Continued)

IN THE SHANDAKEN TUNNEL, NEAR FOOT OF SHAFT NO. 1

On the left is the 6-inch ventilating pipe running nearly to the heading. Beside this is a 4-inch pipe furnishing air to the drills. On the right is a 2-inch pipe carrying water from the compressor house to the "Water Leyner" drills. In the foreground is a train of muck cars hauled by a "General Electric" locomotive having two 5 horsepower, direct-connected, 110-volt motors; the storage battery has 48 cells. Above this is an instrument platform with brass scale showing in the roof. The wires shown are a 220-volt, 3-line system which carries the lights and furnishes the power to the mucking machine About 500 feet from the heading is a small transformer which steps down the voltage to 110 volts. This furnishes power for the lights in the heading, the rest of the lights being on a 220-volt line. There is also a small transformer about 500 feet from the shaft which steps down the voltage to 110 volts for charging the storage batteries of the electric locomotive. The three lower wires shown are "dead" and will be removed. The rock is a hard gray shale and shaly sandstone.

Relations Between Rainfall and Runoff

Conclusions derived from investigations and studies conducted by the Miami Conservancy District. Effects of surface slope, intensity of precipitation, absorption by vegetation, soil storage cultivation, evaporation and other phenomena.

Of the several most valuable treatises on the technical features studied in connection with the flood control work of the Miami Conservancy District, the latest (which has just appeared) is entitled "Rainfall and Run-off in the Miami Valley." This report was prepared by Ivan E. Houk, district hydrographer.

It discusses the rainfall and run-off records for the valley, experiments on run-off and soil moisture conducted at Moraine Park, experiments with artificial rain (sprinkling) there and at Taylorsville, rainfall and run-off during the 1913 and later floods; and finally the plan employed by the district engineers for forecasting floods.

A brief summary of the conclusions as to rainfall and run-off relations arrived at as a result of these studies is given in the report in the following words:

Rainfall and run-off relations have been studied extensively during recent years. While more or less progress has been made, in methods of investigation as well as in final results, the problem is still far from a complete solution. Early investigators frequently tried to express run-off as a percentage of rainfall; more recently run-off has been considered as a residue remaining after the various losses are supplied. This was undoubtedly a step in advance, since run-off is, essentially, a residue remaining after the demands of evaporation, transpiration, and deep seepage are filled. However, these quantities, themselves, are so variable and are affected by so many factors that no simple accurate formulas for their calculation can be developed. It must be recognized that there is no simple relation between rainfall and run-off and that run-off can be determined from rainfall within narrow limits, only after very careful study of all existing data by experienced hydraulic engineers. Even then the results may be considerably in error.

It will be valuable to point out briefly the more general conclusions regarding rainfall and run-off relations in the Miami valley, which seem to be justified by the data collected.

The Moraine Park records show:

1. That variations in surface slope are of much less importance as affecting run-off than are variations in vegetable cover.

2. That intensity of precipitation has an important effect on the occurrence and amount of surface run-off.

3. That during the summer months rainfall seldom percolates to such depths that it is not raised again by capillarity or by root action and evaporated or transpired back into the atmosphere.

4. That storage in the surface soil, filled during winter rains, furnishes about 5 inches of water to the summer evaporation and transpiration requirements.

The sprinkling experiments (rainfall effects produced artificially by sprinkling) show:

5. That the rate of surface run-off increases as the rate of precipitation increases, the former being directly proportional to the latter when the surface soil is saturated.

6. That the rate of percolation, when the surface soil is saturated, increases as the rate of rainfall increases, the variation being according to a straight line equation and the rate of increase being proportionally greater for loose loamy soils than for heavy clay soils.

7. That cultivation has a relatively important effect in reducing the amount of surface run-off.

The studies of annual run-off show:

8. That annual evaporation, including transpiration, is not constant, but varies with the seasonal distribution and amount of rainfall, as well as with other meteorological factors, the variation for the drainage area above Dayton being slightly greater than the variation in annual rainfall.

9. That annual run-off is much more variable than either annual rainfall or annual evaporation.

10. That annual surface, or flood, run-off is much more variable than the annual low water, or ground water, run-off, the variations in total annual run-off being caused primarily by the variations in surface run-off.

11. That the character and condition of the soil influences run-off to a greater extent than has been generally recognized, and next to rainfall is the most important factor affecting run-off.

The studies of storm rainfall and flood run-off show:

12. That the total retention during similar storms is greater in the summer than in the winter.

Some of the above conclusions are simply confirmations of recognized laws. Others, however, such as number 6, relating to the rate of percolation, are new.

It is believed that the sprinkling method of investigating rainfall and run-off relations offers distinct possibilities; and it is hoped that other investigators will try this out in different parts of the country and on different soils. Of course whenever sufficient funds are available it would be desirable to install lysimeters so that the percolation can be directly measured. Such experiments might be taken up by senior or graduate

students at the various technical colleges. Persons desiring to pursue the matter might secure rainfall and run-off data for different soils, at different seasons of the year, with different surface coverings, and in different stages of cultivation. Data might also be secured on the intensity and duration of precipitation which will cause surface run-off to begin on different soils, covered with different growing crops in different stages of growth. Engineers engaged on projects requiring a knowledge of rainfall and run-off relations can probably secure valuable information in a few months by such methods.

Better information regarding variations in soil absorption, percolation, evaporation, and transpiration caused by variations in soil texture, soil moisture, temperature, rainfall, surface conditions, and so forth, will be of material assistance in studies of flood run-off and storm rainfall. Probably future studies of the relation between rainfall and run-off will give better results if the flood run-off and low water run-off are considered separately, even though the division between the two may have to be more or less arbitrarily made. This should be especially true where the flood run-off constitutes a large proportion of the total and is as variable as it is in the Miami Valley.

Records of total rainfall and run-off should be published whenever possible, since such information always is valuable to hydraulic engineers. From a large accumulation of such records certain generalizations sometimes can be made. Where the records are of long duration they furnish valuable data for studies of abnormally dry and wet years as well as of the general variations in total amounts. However, such data are of limited application in that they include the cumulative effects of the different fundamental laws affecting these phenomena, and it is doubtful whether a detailed study of such records will indicate very definite relations between the two which can be blindly applied to other drainage areas.

Concrete Injured in Transit

Although the mixing of concrete for highways and pavements at a central plant and distributing it with trucks or cars has many theoretical advantages, there are possible disadvantages also, and this method should be undertaken with care and good judgment and the details should be carefully approved and operations continuously inspected to insure good results. Notable successes have been attained in several places, as for example in Philadelphia, as illustrated a few months ago in these columns, where satisfactory mixing and placing of concrete was described for work for which the contractor established a central storage and mixing plant, and hauled the wet concrete five miles in automobile trucks, depositing it in good condition with little or no tendency to set before it was placed in sub-grade.

If the concrete is not mixed to the proper consistency, if it is not well mixed or if the time of transportation is too long, it may either become set before it is put in place, or it may be subject to serious segregation. Both of these [illegible] concrete being used for highway construction on Federal Aid Project 2 in Illinois, where it was necessary in some cases to remove the segregated portions of hardened concrete from th truck [illegible] with pickaxes, involving a considerable [illegible] of time and delay to the work besides the [illegible] the material. Such difficulties can be obviated by proper mixing, transportation and rapid operation.

Water Works Reports and What They Should Contain*

By R. E. McDonnell†

Why a report should be made; what its appearance and contents should be. Its advertising and educational value.

Some water works superintendents and occasionally city officials, may question the value of a water works report and doubt if it is money well spent. The answer to this question is simple. It depends upon the report.

Water works reports reflect exactly what the superintendent or manager is. Invariably a good superintendent issues a good report. When one examines, as I have recently, a report that contained page after page of fire hydrant locations and another where pages were devoted to statistics fifteen to twenty years old, it doesn't require an efficiency expert to figure out the loss and waste of time and money by issuing such a document. The printer's proofreader was probably the only person who read the entire document. My criticism of water works reports comes from reading them and, therefore, from the standpoint of the consumer, I am going to briefly mention a few features of reports that have made them especially interesting to me.

Why Should a Report Be Made?—a water plant is one of the chief assets of a city; in value it ranks well toward the top of all the city investments, whether owned by the city or company. The success and continued operation of all other industries, factories, etc., are dependent entirely upon the water works. The health, growth and prosperity of the city are entirely dependent upon the purity and cleanliness of its water supply. Its customers extend over the entire city, its commodity sold is standardized and is of one quality. When city owned, every citizen of the town is a stockholder and, therefore, a report to the public is due them and the public further has a right to demand a real water works report, in keeping with the importance of the utility.

Appearance of Report.—Reports, like people, are often judged by appearances and, therefore,

*Paper before the Southwest Water Works Association.
†Of Burns & McDonnell Engineering Co., president of the Society.

it should have an attractive cover and be of a good quality of paper and printing. Like a girl's skirt, it should be long enough to cover the subject, yet short enough to be interesting. The pictures accompanying a magazine article always produce a desire to read the article and photographs and cuts should be freely used to relieve the monotony in printing and statistics.

What It Should Contain.—A brief historical sketch giving date of purchase or date when built and the present value of the property, is always of interest to new customers.

Statistics themselves are rarely read by the layman and these should be converted into graphical diagrams which are understood at a glance.

A concise tabulation of operating costs, annual revenue, fuel costs, increase in number of connections, etc., shown both by figures and graphical charts, are always interesting, but these should not cover more than a ten-year period, as old statistics are of little interest or value.

A population curve and water consumption curve are always well worth the making, as they show what future provision for growth should be made.

A plain statement from health authorities regarding purity of water with percentage of bacteria removed, with cuts or illustrations of bacterial comparison of raw water and treated water, is the best kind of advertising a report can contain, for one must not forget that his business is selling water and the reports help sell the customer.

People always like to know how their money is spent and a graphical diagram showing what part of a dollar goes for interest, labor, fuel and operation is enlightening.

Illustrations showing losses by leaky faucets, bad plumbing and unregulated flush tanks or sewers are helpful in bringing about reforms. Showing customers how much their own bills could be reduced by eliminating all wastage is convincing.

The reduced pumpage, reduced fuel or power bills and increased revenue by universal meter system are features that can and should be shown in every water works report, for even in this enlightened day we find a few communities who still sell, or rather give water away, without meter measurement. The city, corporation or individual doesn't exist that can make a success of selling any commodity without measurement of the amount sold.

The report should show or account for the loss between water delivered and water sold and if this doesn't show a yearly improvement, something is radically wrong and needs correction.

A water works plant is never finished or completed and the needed extensions, betterments and improvements ought always be prominently shown in a report, then there are no shocks or surprises and if bonds are needed there is nothing gained by concealing the fact. Show in the report why the improvements are needed and what advantages and results will be gained by them.

Every report ought to show the cost of delivering water per 1,000 gallons, including interest, depreciation, sinking fund reserve, etc. This in-

fore the public their needs and caused a keen interest in their own utilities. Extracts from reports are desired by the local papers and should be given them. Send each customer one by the meter reader or hand them out by the window collector. Exchange your reports with the officials of other cities of your state.

The water works plant is the chief asset of the city but there is lack of general knowledge concerning it, a fault that we can largely correct by getting out and presenting a genuinely interesting report. Whether it pays or not depends on the report and its presentation.

provements, as a basis for argument for equalizing rates or in securing a raise of rates it is of much value.

A report to be of any value must be interesting, for if not interesting it will never be read. The author of the report or some water works official should personally present a resume of his report before every civic organization of the town, not omitting the women's clubs.

In Glasgow, Scotland, which city prides itself on being the best governed city in the world, the head of each utility or department is required to give, at mass meeting, a public accounting of his utility. For example, the water department head gives the workings of the department, its needs, etc. I listened one night to an address by Thos. Melvin, manager of the sewerage department, on the subject of "The Cleansing of the Clyde River." He told how the Clyde river had been transformed from a foul sewer-like stream to a beautiful river abounding in fish and lined with house boats. The lecture, or really his report, was illustrated with slides and was of much interest. These reports, thus presented, kept beformation is not always known by the superintendent himself and when he figures it out he will in many towns, find that large users, railroads especially, are getting their water at less than its cost of production. When one glances at his own railroad and pullman expense these times, it causes the reflection that railroads ought to have sufficient funds available to at least pay for the cost of furnishing water. In these days of regulation of rates, one cardinal law acknowledged by all is that the rates of each utility, whether a water plant, light plant or railroad, should be based on its value and cost of operation. The railroads or other large users are not mercenary institutions with rates made because of their being a special aid or help to a town. Every report should show what the rates should be to earn this interest, depreciation and operating expenses.

Value of a Report.—It is of much advertising value to the entire community, so much so that many commercial clubs are joining in the expense of printing and circulating water works reports. Every live water works superintendent knows the advertising value to himself of getting out a good report. It places him in a favorable light before many other communities where opportunities for advancement are existing.

The educational value is of greatest importance. It acts as an aid in getting bonds for needed im-

Operating a True Siphon*

The water supply of Hallowell was originally obtained from a brook about 1.5 miles northwest of the city. Two small reservoirs were constructed on this brook and a 6-inch pipe laid from the lower reservoir to two distribution reservoirs just west of the built-up portion of the city. This pipe has its intake about 8 feet below the spillway level, crosses a valley perhaps 40 feet lower and, about 6,000 feet from the reservoir, crosses a ridge where the pipe at its highest point is about 3 feet above high water in the reservoir. From this point the pipe descends sharply to the distribution reservoirs, which are about 41 feet lower than the impounding reservoir. In order to have sunk the pipe below the hydraulic gradient it would have been necessary to excavate the trench through 500 or 600 feet of rock.

The consumption exceeded the supply from this source some years ago, and an emergency connection was made with the pipes of the Augusta water district, and after a time the operation of the siphon became so unsatisfactory that the entire supply was taken from Augusta. During 1918, Hallowell used an average of 210,000 gallons a day, paying Augusta $5,367 for the year's supply.

Prior to its practical abandonment, the method of operating the siphon had been as follows: valves at the inlet and discharge ends of the supply pipe were closed; the air valve at the summit was opened and a supply of water from a small reservoir 20 or 30 feet higher was drawn through a 2-inch pipe into the 6-inch pipe, thus filling the siphon and driving out the air. When all the air had been expelled at the summit, the air valve was closed, the supply cut off from the upper reservoir and the gates at the inlet and discharge ends of the pipe were opened. The siphon then continued to operate without attention until a sufficient quantity of air had accumulated at the summit to prevent its operation. The efficiency of the siphon began to decrease almost immediately and gradually fell off until the flow practically ceased. It was the custom to manipulate the valves at 7 and 11 a. m. and at 4 and 7 p. m., and operating in this way, the siphon worked with a fair degree of success.

The use of the siphon was finally abandoned when the 2-inch pipe used for filling the siphon finally gave out. Owing to the cost of purchasing water from Augusta, it was decided to determine whether the siphon could not again be used and the firm of Metcalf & Eddy was consulted in the matter. They found the Hallowell water supply of excellent quality. The cost of excavating the rock to lower the pipe below the hydraulic grade line was practically prohibitive. It was then suggested that possibly some automatic means could be provided by which air could be removed from the summit as it accumulated. Electric power was readily available from a power line which crossed the summit near the pipe line and there seemed no reason to doubt the practicability of providing an automatically cont[illegible] air pump for removing the air.

No definite information was available as to the amount of air to be removed, except the fact that the siphon had formerly operated for 4 or 5 hours without recharging. The matter was taken up with C. O. Rogers, engineer for the Charles J. Jager Co., who suggested an equipment consisting of a receiver, 24 inches in diameter by 36 inches long, of reinforced steel, with supporting cradles and a 6-inch flange yoke; a water glass and fittings for indicating the water level in the float chamber; a copper deposit float with necessary connections for the operation of a float switch; a triple pole float switch of the enclosed type; a Gardner compressor unit, 3 by 3½ inches, air cooled, with extended motor base and belt and idler drive. Capacity of compressor, 8 cubic feet free air per minute; a 1½ horsepower, 3 phase motor, 1,800 r. p. m. for 220 volt current.

Such an equipment was purchased and placed in a vault 12 feet long, 6 feet 6 inches wide and 8 feet deep, which was built enclosing the pipe at the summit. A tee branch was connected into the pipe and the air tank or receiver was mounted upon this tee. The cost of the vault, including considerable rock excavation, was about $800, the equipment cost $643, and the installation and connection of the apparatus about $100, giving a total cost of something under $1,600.

This apparatus was put in operation on December 15, 1918, and had been in continuous operation when this paper was written, about two years later. The operation is entirely automatic and the siphon is maintained in continuous operation. It is, of course, necessary to throttle the valve at the discharge end of the supply pipe where it enters the distributing reservoir in order to prevent breaking the siphon because of the excessive drop in the lower leg and thus avoid depleting the reservoir too rapidly.

During 1919 the cost of electric power for operating the pump was $85 at 9 cents per k. w. h. and in addition, $9 was paid for electric lights in the vault, making the total cost of current for the year $94. Interest and depreciation on the investment at 7 per cent would give $112 per year, or a total cost of operating the siphon of $206. Even with the siphon operating, some water had to be obtained from Augusta to supplement the inadequate supply, for which the city paid that city $2,146. This makes the total cost of the water supply for that year $2,351, or $3,016 less than when all the water was purchased from Augusta.

When the apparatus was first installed the pump operated about once an hour, but when water in the reservoir became comparatively low much more air accumulated, and in July, 1920, the pump was found to be operating about once in five minutes, the difference in water level in the receiving tank between time of starting and stopping the pump being about 6 inches, which corresponded to an accumulation of air of approxi-

*Condensed from a paper before the New England Water Works Association by Wallace R. Brann, superintendant of water works of Hallowell, Maine, and Charles W. Sherman, of the firm of Metcalf & Eddy.

mately 3 cubic feet. The greater amount of air to be removed at this time may be due to more air entering the pipe at the inlet end in solution or in suspension in the water, possibly to air drawn in through the joints of that part of the pipe which is above the hydraulic grade line and also above ground-water level, more of the line being above such level during periods of low water in the reservoir.

The pump maintains a vacuum of about 24.5 feet of water. The hydraulic grade line at the siphon is therefore about this distance below the pipe at the summit of the siphon.

In discussing this paper, members referred to several other siphons. Frank A. Barbour told of a siphon put in at Woburn about 10 years ago connecting about 25 driven wells with a suction well, the high point being immediately over the well and the air being removed from it by a reversed air compressor. This was a 14-inch pipe about 1,400 feet long.

Edwin C. Brooks told of a 30-inch cast-iron pipe line owned by the Cambridge water works which rose above the hydraulic gradient at one point, but seemed to work perfectly for a time. Then it commenced to fail and on being dug up most of the laid joints seemed to be loose although they had been faithfully driven. These joints were then driven up. Soon after that a new line was built and this section was put out of service

D. A. Decrow told of a 24-inch pipe 9,000 feet long, laid in 1885 in Auburn, N. Y., and used as a siphon, the high point being about 9 feet above the gradient. It had been intended to lay this at grade, but the pipe was kept up to avoid excavating in quicksand. Some provision was made for removing air at the high point and it delivered six or seven million gallons a day without difficulty.

Water-Borne Typhoid in West Virginia

Epidemics due to use of untreated river water or polluted well water, to filter plants run by careless or ignorant operators, to the interruption of chlorine treatment, or to pure negligence.

Under the title: "Reducing the Typhoid Toll in West Virginia," a pamphlet has been issued by E. S. Tisdale, director of the Division of Sanitary Engineering of the West Virginia Department of Health, in which he reviews the accomplishments of that division during the five years since it was organized. Due to defects in the registration laws of the state, complete records of typhoid cases and deaths in different parts of the state are not available, and Mr. Tisdale states that "the only way in which the progress could be clearly seen is by a study of the towns and cities where typhoid outbreaks have occurred. By noting the prevalence of typhoid in these towns now as compared with previous times in the past, we can arrive at a fairly definite conclusion as to the progress which has been made."

Nineteen different typhoid outbreaks attributed to water have been investigated by the division. The report divides these into four groups, the first consisting of typhoid outbreaks caused by the use of untreated river water; the second consisting of epidemics due to failure of filtration plant to function properly; the third, mining camps where the outbreaks were traced to infected wells; and the fourth, outbreaks caused by the interruption of chlorination treatment of the water.

UNTREATED RIVER WATER

The first group comprised St. Albans, Dunbar, Piedmont, West Union, Gassaway, Clay Court House, Rowlesburg, Spencer and Philippi. Six of these were given immediate relief by the installing of an emergency chlorinating plant by the State Department of Health, which owns two emergency plants of this kind. (In addition to keeping these emergency plants, the department keeps on hand spare parts for such plants of both wet feed and dry feed type, which are loaned to communities using chlorine until they can be replaced by parts obtained from the manufacturers.) In each of these towns the typhoid outbreak was traced to the water, which in one case was served to the people through the medium of ice cream and soda water, in preparing which a local drug store used a public supply which was not intended for domestic consumption, the homes all being supplied with wells.

POORLY OPERATED FILTER PLANTS

The second group included Charleston, the capital of the state, Williamson and Weston, two epidemics having occurred in Charleston. This city was served with water that was treated by a filter plant which was being run by operators who "were ignorant of the real danger, besides having no adequate conception of the operation methods of a modern filter plant, the proper use of the alum or the correct amount of chlorine dosage." A typhoid epidemic occurred in the summer of 1917 and was investigated by both the state department and the United States Public Health Service. The recommendations of these were not carried out and a second epidemic occurred in the summer of 1918.

In the 1917 epidemic there were 210 cases and 10 deaths, and in 1918 168 cases and 31 deaths. In the latter year there had been a rapid increase of residents because of war activities, and disastrous fires had heavily overtaxed the filter plant, with the result that impure water was pumped into the mains. In 1917 the company had employed an expert bacteriologist and chemist, but owing to the refusal of the ignorant filter operators to follow his directions, the plant was not operated effectively. Following the second

outbreak, city, state and federal authorities united in their demand for action by the water company and emergency wooden filters were hurriedly constructed, the rate of chlorination raised to approximately one part per million, and a competent consulting engineer was employed by the water company to design a new million-gallon sedimentation basin, additional filters to double the capacity of the plant and suitable pumping equipment. The new plant is now in operation, better trained filter operators are at work under a competent chemist and bacteriologist who makes daily tests and files weekly reports with the State Department of Health, and chlorination at a rate of 0.5 part per million is maintained, with the result that a safe water is being supplied. The result has been a reduction of the typhoid death rate to 14 in 1919 and 3 in 1920, while the reduction in cases has been even greater.

In Williamson, the rapid filter plant was not provided with a sedimentation basin, and hypochlorite as well as alum was being introduced into the suction line of the pipe that raised the water from the river to the sand filters. During the winter, when the stream was muddy, this plant could not purify adequately and the number of cases of typhoid usually increased.

In Weston there was a serious typhoid epidemic in 1919 due to the breaking down of the filter plant in the spring of that year and 40 or 50 people in this town of 4,000 contracted typhoid fever during the summer while the filter plant was not operating properly. Since 1916 the water had been treated with liquid chlorine. During 1918 and the spring of 1919 the superintendents at the plant were incompetent, rapid deterioration took place, the filters were abused, chemicals improperly applied, the motors for the pumps burned out, the chlorinator fell into disuse, and, in short, the whole plant was reduced to a mass of junk and practically raw river water was pumped to the reservoir. The State Health Department took emergency measures, including having a new chlorinator installed and later the entire filter plant was overhauled, new sand and gravel placed in the filter, chemical tests were started to control the amounts of soda and alum and regular daily records of filter operations are kept accurately and filed weekly with the State Department of Health.

POLLUTED WELLS IN MINING CAMPS

The state department was called in by the physicians at Ronda, a mining camp, when 15 cases of typhoid occurred in a community of 230. These obtained their water supply from a dug well that was not protected by a curb or otherwise from the entrance of surface water. The well was closed and a new supply provided. In Ivaton, another mining camp, 8 cases were reported in December and were traced to a poorly protected dug well. As no other source of supply was available, water from this well was disinfected by use of hypochlorite of lime, the well was thoroughly cleaned out and protected against surface drainage. In the spring the mining company installed a new supply from a deep drilled well.

The most severe outbreak in a mining camp was that at Loma. Here the supply was from drilled wells which, however, had not been capped and there was no protection against surface drainage. Sanitary conditions generally about the camp were very bad and flies were breeding by the millions. There was a general slope of the ground toward the well that was used by most of the people in the camp, and following heavy rains 35 of these contracted typhoid fever and 4 deaths occurred. Here the wells were disinfected with hypochlorite of lime and were capped tightly and protected by a concrete slab. In addition, the customary sanitary precautions were taken throughout the camp.

INTERRUPTION OF CHLORINATION

In the fourth group, Elkins with a population of 7,500 had over 100 typhoid patients in March, 1918, in spite of which it was only by accident that knowledge of this reached the State Health Department. Investigation by the department showed that the city authorities for more than two months were unable to obtain chlorine gas for the chlorinator and untreated water was pumped into the city main without the people being notified of the fact. During this time the winter rains brought a great deal of pollution into the river from communities above, where there had been typhoid fever. A supply of chlorine gas reached the city the same day as the engineer of the health department, and the water system was immediately flusned out, including the intake well, reservoirs and distribution system, and the use of chlorine was renewed with a high rate of dosing in order to remove any possible infection that might remain in the distribution system. There was no filtration plant here; had there been, it is believed the epidemic would have been much less severe, if it had not altogether been prevented. The city has had plans for a filtration plant prepared.

Fairmont had 195 cases in three months in 1918. Here a filtration plant had been built in 1906, but was wholly inadequate for present conditions and was being entirely by-passed. Incidentally the state department reports that Fairmont paid $300,000 for this filter which was simply an experiment of its engineer, the theory being that water could be filtered by passing either upward or downward through it. A chlorinator had been installed in 1916, but was unsatisfactory, and had been boxed up ready to return to the factory and the city was receiving river water without any treatment. A new chlorinator was obtained as soon as possible and has been conscientiously operated since that time, while complete plans have been prepared for a modern water purification plant.

Clendenin was supplied with river water which was chlorinated, but heavy rains on the watershed caused the river to carry much mud and leaves which clogged the strainer in the chlorinator so rapidly that it was impossible to keep the apparatus running. The chlorinator was shut down for a number of hours when conditions were at the worst and untreated water was pumped into the mains and this was followed by an outbreak of 15 cases of typhoid. "In order to over-

come such clogging of the apparatus in the future, a contrivance was devised which has not only worked admirably here at Clendenin but also has been adopted all over this state where chlorinators are treating raw river waters. On the water-line leading to the apparatus a piece of pipe 8 inches in diameter and 3 feet long was inserted in a vertical position. The muddy water flowing through this pipe became quiet with the result that dirt, sand and sediment sank to the bottom of this stilling chamber, the clearer water passing on to the chlorinator."

The state board calls attention to the absolute necessity for continuous treatment with chlorine gas where this is the sole safeguard of the water supply and therefore urges duplicate apparatus under such conditions. It is, of course, desirable to provide filtration as well as chlorination. At present all persons in charge of water works where chlorine apparatus is maintained are required to mail to the State Board of Health once a week a card giving for each day of the week the gallons of water pumped per hour, the rate of chlorine used and the river conditions. This has been required now for two years past and has proved practical and helpful. "It has stimulated interest in the chlorinator operation by the men in charge and has kept the office in touch with all the chlorine plants constantly." The key to the success of this weekly reporting plan of checking up chlorine treatment has not been the force of the law but the personal contact between the water works official and the sanitary engineers of the department.

PURE NEGLIGENCE

One case is reported by the board which it considers as a class by itself, this being Wheeling, the largest city in the state with a population of 55,000, which, until 1919, pumped the grossly sewage-polluted water of the Ohio river direct into the mains without any treatment. Prior to that time the average death rate from typhoid fever was believed to have been 56.8 per 100,000. Even yet, in the spring of 1921, Wheeling remains an ignominious example of disregard of its citizens' welfare in this respect.

It is estimated that since 1910 there have been in the city 3,300 cases and 220 deaths from typhoid. The city had been urged to take some action, but not until the end of 1918 was the department able to persuade it to install a chlorination equipment. In 1917 the case rate was 200, and was 155 in 1918, but was only 28 in 1919 and up to April, 1920, only 7 cases had been reported. In April, however, the freight embargo prevented the city from obtaining chlorine and there was an immediate increase, 28 cases being reported up to July 1. Even with these experiences to urge haste, however the city has not yet installed a filtration plant although last December the council decided to have preliminary plans prepared for a modern purification system.

The report contains charts showing the great difference between number of typhoid cases in cities supplying raw water and those supplying filtered and chlorinated water. It also has a similar chart showing the superior effect of both filtration and chlorination over chlorination alone. It compares Huntington, with both filtration and chlorination, with Wheeling, which has chlorination alone; the former reducing water-borne typhoid to a very low figure, while Wheeling probably does not eliminate more than 70 per cent to 80 per cent and has a considerably greater number of typhoid cases than has Huntington.

The report concludes with a reference to the death on March 14, 1921, of a member of the legislature who died of typhoid fever on that day, and urges the legislature to pass a budget for the State Department of Health, as recommended by the budget committee, as a memorial to their fellow-legislator.

Outfit for Measuring the Level of Liquids

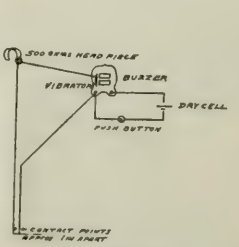
By S. W. Tay

The following is a description of a device constructed for the purpose of gauging the flow of sewage in the Honolulu sewers. Hourly readings were taken with this outfit both day and night at numerous manholes and no trouble was experienced in obtaining accurate results. It was quite easy to read to one one-hundredth of a foot. Errors due to eddies exceeded those due to the apparatus.

The outfit consists of a wireless head receiver, dry cell, small electric buzzers, push button, engineers' tape, weighted copper contact points with sufficient flexible wire to permit contact points to reach water level. The whole is assembled in an inexpensive imitation leather case.

When in use, the head receiver is placed in position and contact points lowered by means of an engineer's tape attached to them; the operator at the same time is playing out the flexible wires until the points are within a short distance of the water. The buzzer circuit is then completed by pressing the push button. The sound of the buzzer is loud enough to be heard by the operator with head piece on, and he can tell if the buzzer is working properly. He then slowly lowers contact points until a loud buzzing sound is heard in the receiver. The reading of the tape is noted from any convenient benchmark.

The above apparatus was assembled by Dr. A. Romberg, University of Hawaii, for board of engineers composed of A. R. Kellar, Geo. Collins and S. W. Tay.



Wiring Plan. Sketch Showing Contact Points

COMPACT PORTABLE OUTFIT FOR MEASURING LEVEL OF LIQUIDS BY DAY OR NIGHT

PUBLIC WORKS

Published Weekly
by
Municipal Journal and Engineer, Inc.
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 248 W. 80th St.,
New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba....$3.00 per year
All other countries .....$4.00 per year

Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

CONTENTS

WORLD'S LONGEST TUNNEL FOR NEW YORK'S WATER SUPPLY—Illustrated 465

$250,000,000 Public Works Bill 471

RELATIONS BETWEEN RAINFALL AND RUN-OFF 472

Pavement Concrete Injured in Transit 473

WATER WORKS REPORT AND WHAT THEY SHOULD CONTAIN—By R. E. McDonnell 473

OPERATING A TRUE SIPHON 475

WATER-BORNE TYPHOID IN WEST VIRGINIA 476

Outfit for Measuring the Level of Liquids—Illustrated—By S. W. Tay 478

EDITORIAL NOTES 479

Ineffectively Operated Filtration Plants—Importance of Run-off Data—Tabulated Data on Rates, Finances and Labor

Municipal Waste of Water 480

Water Department Uses Machinery 480

METER RATES—FINANCES—LABOR—Table.... 481

Ineffectively Operated Filtration Plants

How many water purification plants are ineffectively operated by men who "have no adequate conception of the operation methods of a modern filtration plant, the proper use of the alum, or the correct amount of chlorine dosage?" (This is quoted from a state health department report that is discussed at length in this issue.) That some are, is known. That many more may be, is more than probable.

One of the most important duties of state and federal health authorities is the remedying of such condition wherever it may exist. A water purification plant so operated as to be ineffective is worse than useless, for it gives an unwarranted sense of security to the consumer, it possibly leads to his abandoning the use of a supply that is actually safer than the one which is supposed to be purified but which is not, and a continuous use by the consumers through many years, of a purified water decreases their partial immunity to typhoid and thus renders them more subject to the attacks of typhoid bacilli that may reach them through ineffective purification than they would be had their systems acquired partial immunity by becoming accustomed to drinking water so contaminated.

If it is important to require the licensing of a physician who serves a few hundred patients, how much more important is it that the possession of specified requirements and the obtaining of a license based thereon should be required of those who operate water filters and thus control the health and lives of an entire community? Such regulations should, in our opinion, be enforced by the boards of health of all the states of the country in every community where filter plants are operated.

Importance of Run-off Data

Where there is reason to believe that the supply of water available from a watershed whose use is contemplated is not considerably greater than the requirements, more or less definite knowledge of the amount of run-off is very important for determining whether the yield will meet the requirements. In addition, the average and especially the maximum yield is frequently a matter of vital importance for the designing of spillways, flood protection works or other reasons.

An unusually thorough investigation over a large area has been conducted by the Miami Conservancy District in connection with its project for controlling the floods of the Miami river and its tributaries. The results of this investigation have recently been made public, and the general conclusions are published elsewhere in this issue.

While investigations of this kind are of the greatest value not only for the purposes for which they were made, but also for the general information of hydraulic engineers, it must be understood that few of the specific conclusions from the investigation of a given watershed are generally applicable to other sheds, and even some of the more general laws may be modified in an unknown way by variations in local conditions.

The rainfall on two watersheds separated only by a single range of mountains may vary greatly, and the percentage of run-off likewise vary; while differences in geological structure, in amount of cultivation, of swampy land, in slope or other topographical features, may cause differences in run-off which would not be suspected by those who have not made wide study of the subject.

As an illustration of the different rainfall rates that may be found under apparently similar conditions of location and topography may be mentioned those of the Schoharie watershed of New York's water supply (referred to in the leading article in this issue) and of the Esopus watershed which lies immediately south of it, both being portions of the Catskill mountains. In spite of this propinquity, however, the average rainfall on the Esopus shed is found to be 56.22 inches per year while that on the Schoharie is only 39.48 inches. Nearly as great a dissimilarity is found also in the percentage of run-off on these two sheds. Much greater differences are found in the far west, where the Cascade range causes such heavy precipitation on the westward side that lit-

tle moisture is left in the winds that cross the range, and the lands to the east receive only a percentage of the rainfall found on the western slope.

It is doubtful whether there will ever be a science of rainfall and run-off sufficiently comprehensive and exact to permit an accurate estimate of run-off from any given watershed of large extent without obtaining rainfall records and making run-off investigations on the shed itself.

It is therefore important that city, state and federal authorities systematically collect records of rainfall and stream flow on all the areas under their control, to be used in future investigations and utilizations of watersheds on such area; since the value of such data increases as the square or some higher power of the length of time over which the collection of them has extended.

Tabulated Data on Rates, Finances and Labor

In this issue we publish tabulated data from several hundred cities giving information that was furnished through the kind co-operation of the superintendents or other officials of the water works of these cities, in reply to questions that seemed to us timely. Finances and the labor question are troublesome almost everywhere now, and these replies tell whether cities have increased their rates or in what other way they have met the increased costs, and to what extent the costs have increased. Also they tell how wages compare with those paid before the war.

Many of these replies are exceedingly interesting, and we hope later to give articles enlarging at length upon the facts so briefly stated. Also we expect in a week or two to comment upon the data, summarizing them and basing upon them a birdseye view of conditions throughout the country.

We believe that they contain the latest, most complete and most authoritative collection of facts along these lines that have been published during the past year.

Municipal Waste of Water

Although the water department of Springfield, Mass., is not permitted to charge the city for water used in municipal service, it has installed meters on many of the municipal services, such as schools and other public buildings in order to bring home to the officials the amount of water which it knew was being wasted. In their report for 1920 the commissioners say that this "has called attention of the city authorities in tangible form to the extravagant and unnecessary waste of filtered water in many of the municipal buildings and has resulted in large reduction of such waste in past years.

"It is the policy of our inspection division to keep those in charge of the different city properties informed as to wasteful conditions needing attention and to cooperate with them in the matter so far as may be possible.

"It is believed that the installation of meters on all the remaining unmetered municipal services possible to be metered should be continued and completed as soon as the necessary funds therefor may be available; and that the municipality itself, as owner of the water supply and as its largest consumer, should at all times set a good example to the numerous private consumers in the proper conservation of this most important necessity."

During the year 1920, 93 per cent of the water used in schools was believed to be metered and about 90 per cent of that used in other public buildings, and 73 per cent of that used in public parks. Approximately 157 million gallons were used in schools, 63 million in other buildings, and 55 million in parks. It was estimated that over 96 million gallons were used by the sewer department in flushing, although this was not metered.

The estimated value of all the water used for municipal purposes was $76,459.

Appraisal of Water Works Properties

The Board of Water Commissioners of Springfield, Mass., in 1920 took final action towards securing an appraisal and classification of the water works plant and property, which action had been recommended by a special committee on appraisal after several years of study and consideration. The appraised value was given at $5,385,430, which was adopted as the revised capital cost as of December 1, 1919. There were also adopted certain rates of depreciation to be applied to each of the several classes of structures and other property, to be used as a basis for future depreciation charges and reserves.

Of the total value, $415,144 was for land and easements, $121,612 for buildings, fixtures and grounds, $4,343,517 for structures and equipment and $505,157 for intangible assets.

Depreciation charges are to be deducted annually from this amount, the decrease for 1920 amounting to $90,173.

The rate of depreciation varies with the item to which it is applied, from a minimum of 1 per cent to a maximum of 25 per cent. One per cent depreciation was charged against reservoirs, canals, dams, etc., a sedimentation basin and a stores equipment yard. One and one-half per cent was charged against most of the buildings owned by the department. Two per cent was applied to most of the mains, although two large mains were assigned a 3 per cent rate. Five per cent was applied to a stand-pipe, to lighting equipment, telephone service and certain other items; 10 per cent to a coagulant plant and to shop equipment and tools. Fifteen per cent was charged against team equipment and 25 per cent against auto equipment.

The commissioners have adopted a form of financial statement that is comprehensive but not unduly long and that shows all of the essential financial dealings and conditions of the department.

Meter Rates—Finances—Labor

City and state	Private or municipal	Present wages of common labor	Hours per day	Wages of common labor in 1914	Hours per day	Present meter rates: f-per 100 cu.ft., g-per 1,000 gals.*	Meter rates* in 1914	Operating costs in 1920 per 1,000,000 gals. of water delivered	Operating costs in 1914	Method of meeting increased costs of last three years	Has plant lapsed in condition or capacity because of finances
Alabama:											
Albany and Decatur	P	$2.00	10	$1.25	10	....	$0.40g	....	....	From surplus	No
Gadsden	M	2.50-2.75	10	1.00-1.50	10	$0.25f	.25f	$34.81	$33.28	Operation cut $5,000 by electrifying plant	No
Jasper	P	3.00	10	....	..	.30g	.30g	....	....	....	....
Mobile	M	3.50-4.00	9	2.00-2.50	9	.15g-.10g	.15g-.06g	22.65	19.50	Reduced consumption and increased rate	No
Opelika	M	2.00	8	1.00-1.50	10	.25g	.25g	40.00	55.00	From income	No
Arizona:											
Clifton	P	3.50	8	2.00	8	1.00g	1.00g	154.00	139.00	From income	No
Arkansas:											
Marianna	M	2.50	10	1.50	10	.50g	.40g	350.00	120.00	Metering services	Yes
California:											
Anaheim	M	4.00	8	2.25	8	.13 1-3f	.10f	24.00a	....	General fund	No
Grass Valley	M	4.00	8	2.50	8	No meters b	....	b	....	....	No
Ontario	M	3.20	8	2.80	8	.07½f	.05f	....	....	More efficient methods	No
Oxnard	..	3.50	8	4.00-5.00	8	.08f-.15f	.08f-.15f	....	....	From surplus	No
Palo Alto	M	4.00-4.50	8	2.50	8	.12f	.09f	107.60c	142.00	Increased rates	No
Pomona	P	3.50	8	2.25	9	.16 2-3f	.16 2-3f	Double 1914	....	Reduced force, drew on surplus, borrowed	Yes
Redlands	M	2.50	8	2.75	8	.08f	.07f	21.20	12.50	Increased rates	No
Redwood City	Pd	4.50-5.00	8	2.50	8	.30g	.30g	....	....	From city treasury	No
Sacramento	M	4.625	8	3.00	8	Flat rate	....	13.27	100% greater	....	Yes
Santa Cruz	..	4.00	8	2.50	8	1.00f	.75f	....	....	....	No
Watsonville	P	4.00	8	2.25	9	.16 2-3f	.11?f	63.00	11.00	Increasing rates, reducing force	....
Colorado:											
Rocky Ford	M	4.00	8	3.00	8	1.35g-.20g	....	95.09	....	Keeping expenses down	....
Connecticut:											
Bridgeport	P	2.70	9	1.75	10	.03- 13f	.03- 12f	....	....	Bonds, reducing force	Yes
East Hartford	M	4.00	9	2.00	9	15-.30g	.15-.30g	....	....	Sinking fund, reducing force and expenses	No
Naugatuck	P	3.60	8	2.00	9	15g	15g	....	....	....	Somewhat
New London	M	4.00	8	2.00	9	.16-.06g	.16-.06g	56.69e	38.98e	Increased revenue for maintenance, bonds for reservoir	No
Portland	P	3.60	9	2.50	9	25-.13g	.25-.13g	....	....	Reducing force	No
Putnam	M	3.60	9	1.75	9	.25g	.20g	1.00	0.94	Raised rates; bonds for extensions	No
Southington	M	3.60	9	1.75	9	.20-.05f	.25-.06f	27.42f	15.38f	Economy in operation, curtailing new work	Somewhat g
Westport	P	3.00	8	2.00	10	.15f	.12f	87.00	60.00	Electric plant carried deficit	No
Willimantic	M	3.60	9	....	..	.25g	.25g	....	....	....	....
District of Columbia:											
Washington	M	3.44+.77 bonus	8	1.75	8	.075-.05f	.06-.04f	10.83	4.35	Congressional action	No
Florida:											
Ft. Myers	M	3.50	9	2.25	9	.50-.25+.20g	.50-.20 & .15g	500 per mo.	325 per mo.	Raising water rates	No
Georgia:											
Americus	M	1.25	10	.75	10	.20g	.20g	118.00	59.50	Drawing on surplus	No
Auburn	M	1.50	10	1.00	10	.40 sliding scale g	.25 sliding scale g	120.00	80.00	Cutting down force, taking care of small wastes, increasing rates	No
Augusta	M	2.70	9	1.50	10	.25 less 20%g	.10 net g	20.03	12.01	Reducing waste	No
Bainbridge	M	1.75	5	1.25	10	.10g	.10g	....	....	Reducing consumption & funds from city	Yes
Carrollton	M	2.00-2.25	10	1.00-1.25	10	.33 less 10%f	33 less 25%f	90.00	60.00	1914 30% metered, 1921 95%	No
La Grange	M	1.50	9	1.25	10	.20-.12g	.25-.10g	10.50	8.50	Surplus	No
Moultrie	M	1.50	10	1.25	10	.25g	.20g	119.00	110.00	Cutting force & other expenses	Somewhat
Quitman	M	2.00	10	1.75	10	.20g	.20g	240.00	100.00	City treasury	Yes

METER RATES—FINANCES—LABOR—(Continued)

City and state	Private or municipal	Present wages of common labor	Hours per day	Wages of common labor in 1914	Hours per day	Present meter rates: f-per 100 cu.ft.; g-per 1,000 gals.[4]	Meter rates* in 1914	Operating costs in 1920 per 1,000,000 gals. of water delivered	Operating costs in 1914	Method of meeting increased costs of last three years	Has plant lapsed in condition or capacity because of finances
Georgia (continued):											
Rome	M	2.25	10	1.25	10	$.07½-.15f; .10 to .20g	$.07½-.15f; .10-.25g	$62.50	$34.50	City treasury drawing on surplus, cutting force, reducing consumption	No
Thomasville	M	1.50	10	1.00	10	.18g	.15g	142.00	95.00	By profits from elec. light plant	No
Visalia	..	4.00	8	2.00	8	.12½-.25g	.12½g-.25g	50% higher than in 1914	....	.....	....
Idaho:											
Lewiston	M	4.50	8	2.25	8	.06f	.06f	5.36	6.38	Reducing consumption, through meters	No
Weiser	M	3.80	8	2.50-3.00	8	.20-.08f	.20-.10g	....	....	By transfer, from light and power funds	No
Illinois:											
Bushnell	M	4.50	9	2.75	9	.25g	.25g	85.00	60.00	Reducing consumption & funds from treasury	No
Cairo	P	3.00-5.00	9	1.50-3.00	9	.08-.25f; .07-.17g	....	....	....	Rates raised	No
Carrollton	M	3.00	8	2.50-3.00	8-9	.30g	.30g	....	....	Income from water rentals	Somewhat
Dixon	P	.45 hour	8 & 9	.25 hour	8 & 9	.25½f	.15f	127.00	59.00	Drawing on surplus & loans from banks	No
Herrin	M	6.00	8	2.80	8	.70g	.40g	72:35	....	Increased rates	No
Lincoln	P	3.60-4.00	9	1.75	9	.18-.08; .55.04½f	.22f	.06	.03½	Cutting down maintenance, refusing new extensions or betterments	Yes
Mattoon	M	4.00	10	2.00	10	.06-.40g	.04½-.25g	33.52	22.00	Increasing rates	Yes
Mt. Carroll	P	.40	9	.25	10	.25g	No increase	....	....	.....	Yes
Murphysboro	P	4.00	8	2.00	8	3.68-.07.5g	.25-.05g(h)	....	....	.....	No
Oak Park	..	.55-.65	9	.25-.30	9	.18-.15g	.18-.15g	130.00	100.00	Less employees	No
Pana	M	.50	8	.50	8	.30-.12g	.30-.12g	....	....	w. w. returns placed in other funds	No
Quincy	M	3.00-4.00	10	2.00-2.50	10	.45-.14.4g	same	....	....	.....	No
Rochelle	M	4.00	10	3.00	10	.21-.09f	.21-.07f	....	....	From treasury, reducing force and consumption	No
Rock Island	M	4.00	8	2.10	8	.14-.06f	same as 1921	....	....	Less extensions	No
Waukegan	M	5.00	8	3.00	8	.17-.06g	.17-.05g	....	....	Drawing on surpl., no imprvts.	Yes
Indiana:											
Bedford	M	.45	10	.20	10	.07-.40g	.07-.40g	....	....	Drawing on surplus	Yes
Bluffton	M	4.50	10	2.25	10	.23-.17g	.21-.11g	16,750	12,243	Cutting down force	Yes
Covington	M	3.00	10	1.50	10	.15-.25g	same f	....	....	Using surplus	No
Delphi	..	3.50	10	2.00	10	.07-.40g	same	36.95	90.28	Elec. pumping units in place of steam	No
Elkhart	P	.40	9-12	.15	9-12	.12-.08g	same	14.00	5.00	Draw. on sur. & reducing force	No
Elwood	P	.50	9	.20	9	.28g	.25f	....	....	Pub. Service Com.	Somewhat
Evansville	M	3.60	8	2.00	8	.05-.20g	same	58.82	23.14	Drawing on surplus and reducing consumption	No
Ft. Wayne	M	.50-.60	9	.22½	9	.12-.45f; .16-.06g	.075-.045 f; .10-.06g	.07024	.06984	Reducing consumption	No
Jasonville	M	3.50	9	1.50	5	.35g	.35g	75.00	54.00	Drawing on surplus	Yes
Kendallville	M	3.60	9	2.25	9	.25-.10g	.25-.10g	....	....	More efficient machinery	No
Knightstown	M	.35	9	.20	9	.25-.08g	.25-.06g	90.00	....	Cutting consumption by metering & cutting forces	No
La Porte	M	3.50	10	1.75	10	.10-.04g	same	49.89	36.26	.....	No
Lebanon	M	4.50	9	2.75	10	.14-.25g	.10-.25g	1.56	.75	.....	No
Linton	M	5.00	9	2.00	9	.12½-.43g	.10-.35g	....	....	Increase in rates	No
Mishawaka	M	.40	9	.22½	10	.10f	.09f	....	....	.....	....
New Albany	P	3.50-4.00	9	2.00-3.00	10	....	....	80.00	50.00	Increased rates	No
Richmond	P	3.50	10	1.75-2.00	10	.20-.06½g	.20-.05¾g	....	....	Increased rates	No
Rising Sun	P	4.00	10	2.00	10	.35g	.25g	190.00	130.00	Drawing on surplus & debt	Yes
Rockport	P	2.75	9	2.00	9	.30g	.25g	.283	.18+	Increased rates	....
Rushville	M	3.50	10	2.50	10	2.00f; .20g	1.85f; .18g	....	....	Drawing on surplus	No
Seymour	P	3.00-3.50	10	1.50-2.50	10	.30-.08g	.40-.12g	....	....	.....	....
Shelbyville	P	.30	10	....	..	.30g	.30g	5.62 per 1,000	....	.....	....
Tell City	M	2.00	9	1.50	10	.30g	.20g	9.25	5.75	City treasury	No
Terre Haute	P	3.50-4.50	10	2.00-2.50	10	.35-.07g	.30-.04¼g	....	....	Increase in rates, cutting out div., reducing consumption	No
Wabash	P	.30	9	.20	10	.25-.05f	same	43.6 pumped	no record	Loans and surplus	No

METER RATES—FINANCES—LABOR—(Continued)

City and state	Private or municipal	Present wages of common labor	Hours per day	Wages of common labor in 1914	Hours per day	Present meter rates: f-per 100 cu.ft.; g-per 1,000 gals.*	Meter rates* in 1914	Operating costs in 1920 per 1,000,000 gals. of water delivered	Operating costs in 1914	Method of meeting increased costs of last three years	Has plant lapsed in condition of capacity because of finances
Iowa:											
Algona	M	5.00	10	3.00	10	$.40-.20g	$.40-.20g	$100.00	$95.00	Increase in rates	No
Atlantic	M	4.00	10	2.50	10	.30-.10g	.30-.10g	90.00	30.00	Bond issue and surplus	No
Boone	M	4.00	8	2.25	9	.50-.08½ f	.35-.12g	150.00	150.00	.....	No
Burlington	P	.50-.40	9-8	.20	8-9	.30-.12½g	.25-.12½g	58.39	38.20	Increased rates	No
Cedar Falls	M	.40-.50	8-9	2.50	10	.22½-.05f	same	59.50	42.50	Drawing on surplus	No
Cherokee	M	.35	10	.25	10	$1.87 per m f; 25g	same	....	....	Tax levy, revenue from plant	No
Colfax	M	.50	8	....	8	....	.30-.10g	....	....	Rates support expense	No
Eagle Grove	M	.40	10	.30	10	.30-.09f	same	....	....	Cutting force	No
Ft. Madison	P	4.80	8	1.50	9	.60 down g	.40 down g	....	....	Raise in rates	No
Iowa Falls	M	4.00-5.00	8	2.00-2.50	10	.40-.20g	.35-.15g	....	....	Increased consumption & rate	No
Knoxville	..	3.60	9	2.50	10	45f-.60g	.30f,.40g	112.00	81.00	Cutting force—meters	No
Maquoketa	M	4.00	10	2.50	10	.16 2-3-.10g	same	45.00	40.00	From surplus & new services	No
Marshalltown	M	.40	8	2.50-2.75	8	.40-.07½g	same	66.00	45.00	Cut in extension work	No
Mt. Pleasant	M	.40	9	.20	9	.50-.20g	.50-.20g	....	....	From city treasury, drawing on surplus and cutting force	No
Muscatine	M	4.00	9	3.00	9	.25f	.25f	50.00	34.00	Drawing on surplus	No
Osceola	M	.30	..	.25	..	.75g	.50g	....	....	Raised water rates	No
Ottumna	M	4.00	8	2.00	8	.25-.06½g	same	51.75	25.00	By development of water power and sale of surplus power	No
Sioux City	M	.45	8	.60	8	.25-.10g	same	69.11	42.66	20% service charge	No
Washington	M	.55	9	.25	10	.30f,.40g	.30f,.40g	....	....	Bonds	No
Kansas:											
Atchison	P	3.60	8	2.00	8	.35-.09g	.30-.10g	12.00	7.00	Increase in rates	Slightly
Cherryvale	M	3.50	8	2.50	8	.50g	same	12.00	8.00	Cutting down force	No
Council Grove	M	3.00-3.50	8	2.50	8	.30g	.30g	116.00	80.00	Funds from city treasury	No
Emporia	M	3.20	8	1.75	8	.30-.06½g	.25-.05g	.....	.....	.....	No
Ft. Scott	M	4.00	8	2.00	8	.27½-.065f	.27½-.25g	80.00	50.00	Better collections and management, cutting fuel cost	No
Fredonia	M	3.20	8	1.60	8	.10-.25g	same	....	....	.....	Slightly
Great Bend	P	3.20	8	2.50	10	.30g	.30g	100%	200%	Poorer service and maintenance	Yes
Herington	M	3.20	8	2.40	8	.20-.40g	.10-.20g	....	....	By electric end of revenue	Yes
Hiawatha	M	3.20	8	2.40	8	.40g	.40g	45.00	50.00	Funds from city treasury	No
Holton	M	3.20	8	2.00	8	1.00-.15g	.60-.30g	.20	.16	.....	....
Humboldt	..	.40	8	.35	8	.35g	.25g	.18	.08	Additional levy	No
Hutchinson	P	3.20	8	2.00	10	.20½ av. g	.18 av. g	112.50	88.20	Deferring maintenance & drawing from surplus	Yes
McPherson	M	.40	8	.30	8	.25g	.25g	....	....	.....	No
Manhattan	M	4.00	8	2.00	8	.15f,.20g	same	....	....	Bond issue & drawing on surpl	No
Newton	M	3.00-5.00	8	2.00	8	.25-.11f	.25-.15g	....	....	Minimum of improvements	No
Osage City	M	3.20	8	2.00	8	.40g	.30g	....	....	Raised rates	No
Osawatomie	M	.50	8	.30	8	.35-.12g	.30-.06g	.....	.....	.....	....
Pittsburgh	..	4.50	8	2.50	10	.25-.10% dis. g	.50-20% dis. g	112.10	80.00	.....	No
Topeka	M	3.75	8	2.75	8	....	....	14.31	9.6	Reducing force, cutting exten	Yes
Kentucky:											
Catlettsburg	P	4.50	10	1.25	10	.35-.09g	.25-.08g	....	....	Cutting force & drawing on sur	....
Covington	M	4.00	8	3.00	9	.18f	.14f	.12½	.8	.....	Yes
Hopkinsville	P	.30	9	.15	10	.36-.15g	.30-.10g	151.	140.	Increase of floating debt	No
Mayfield	M	.30	9	.15	10	.40g	.30g	15.00	9.00	Reducing consumption and increasing rates	No
Nicholasville	M	2.50	8	1.50	9	.35g	.30g	....	....	Drawing on surplus	Yes
Paris	P	2.50	10	2.00	8	.25g	.25g	....	....	.....	Yes
Providence	M	4.00	8	2.00	10	.30-.13g	same f	120.	50.	Increased business	No
Richmond	P	3.00	9	5.00	8	.27½f	.27½f	....	....	.....	....
Louisiana:											
Baton Rouge	P	2.50	9	1.25	9	.26f,.35-.10g	same	....	....	Adding pipe line to take additional territory	No
Kentwood	M	2.00	10	1.50	10	....	....	....	....	Funds from treasury	No
Maine:											
Bath	M	4.00	9	1.50	9	.30f	25f	.....	.....	Increase in rates	No
Caribou	P	3.50-4.00	9	2.00-2.25	10	.07½f, 10g	same	11.00	8.00	.....	No
Ellsworth	P	3.25	9	1.75	9	.40-.10f	no meters	....	....	Increase in rates	No
Gardiner ... Water Dist.		3.50	9	2.00	9	.20f	20f	....	....	Drawing on surplus	No

METER RATES—FINANCES—LABOR—(Continued)

City and state	Private or municipal	Present wages of common labor	Hours per day	Wages of common labor in 1914	Hours per day	Present meter rates: f-per 100 cu.ft.; g-per 1,000 gals.*	Meter rates* in 1914	Operating costs in 1920 per 1,000,000 gals. of water delivered	Operating costs in 1914	Method of meeting increased costs of last three years	Has plant lapsed in condition or capacity because of finances
Maine (continued:)											
Norway	P	4.00	8	2.50	9	$.20-.25g	same	....	....	.....	No
Rumford	M	2.60	9	2.70	9	.22½f, 2.25g	$.30f, 3.00g	....	....	No increase	No
Sanford	P	3.25-3.50	9	1.85	9	.25g	.25g	....	....	From surplus	No
So. Paris	M	3.50	9	2.00	9	....	....	....	....	.....	No
Van Buren .. Water Dist.		3.25	8	2.50	10	....	....	....	....	Fewer extensions and strict economy	No
Massachusetts:											
Adams	M	4.00	..	2.50	8	.10g	.10g	....	....	Drawing on surplus	No
Amesbury	..	4.00	8	2.50	9	.18¾-.37½f	same	....	....	.....	No
Belmont	M	4.00	8	2.50	8	.20-.15f	same	$62.10	$60.05	Earnings of dept.	No
Brockton	M	.68	..	2.50	8	.19-.10f	.17-.10f	101.5f	58.74	Bond issues, increase in rates	No
Cambridge	..	4.00-4.25	9	2.50-3.00	9	.18½f, .25g	same	97.00	86.00	Surplus earnings	No
Cherry Valley and Rockdale	dist.	3.60	8	1.75	9	....	....	....	....	Increased rates	No
Concord	M	3.40	8	2.00	8	.20-.07½f	same	66.33	44.90	Cutting force and increase hydrant rental	No
Danvers	M	4.00	8	....	..	.13-.25g	.06½-.20g	10.36	16.00	.....	No
Fall River	M	4.20	8	2.25-2.40	8	.24-.10½f	.21-.07½	....	....	.....	....
Falmouth	M	4.00	8	3.00	8	.25g	same	....	....	Incr. in no. of water takers	No
Fitchburg	M	5.04	8	2.00	8	.18f	.18f	....	....	Reducing work	Yes
Framingham	M	4.40	8	2.50	8	.25 & slid. scale f	same	97.35	60.01	Increase in consumption and use of surplus	No
Haverhill	M	4.75	8	2.00	8	.07½-.10 less 15% f	same less 25% f	40.68	18.62	Increased rates	No
Lee	P	3.20	8	1.75	9	....	....	....	....	.....	Slightly
Leominster	M	4.40	8	2.00	8	.14f	.19f	....	....	Funds from city treasury and cutting force	No
Maynard	M	4.00	8	2.00	8	.37½-.10f	.37½-.10f	....	....	.....	No
Natick	M	5.00	8	2.25	8	.25f	.25g	34.68	20.45	Bond issue, increased water rates	No
New Bedford	M	4.75	8	....	..	.10-.15g	same	68.58	66.89	Increased consumption	No
North Adams	M	5.00	8	1.75	8	.05-.11f	.10-.15g	....	....	Increased appropriation	No
Oxford	..	.40	10	.25	10	.50g	.40g	....	....	Increased rates	No
Reading	M	4.00	8	2.50	8	.35-.15f	.23-.12f	....	....	.....	No
Somerville	M	4.00	8	2.15-2.25	8	.12f, .16g	same	....	....	.....	No
So. Hadley Falls	M	4.00	8	3.00	9	.15-.10g	.15-.10g	....	....	Cut down on improvements	No
Springfield	M	.50	8	.28¾	8	.22-.05f	same	212.500	137.000	Current rev. and deferred work	No
Walpole	M	4.00	8	3.00-3.25	8	22½f, .30g	.22½f, .30g	19.75	13.80	Increased rates	No
Williamstown	P	3.50	8	2.00	8	.27-.06f	.22-.04f	....	....	Increase in rates	....
Worcester	M	.50-.62	8	....	8	.20-.10g	.20-.10g	68.81	101.68	Increase in business	No
Michigan:											
Battle Creek	M	5.40	9	2.50	10	.04-.13g	same	43.00	38.50	Drawing on surplus	No
Big Rapids	M	3.50	10	2.50	10	.08g	same	4.00	same	.....	No
Coldwater	M	3.50	10	1.50	10	....	....	....	....	Raising rates, inc. consumption	No
Crystal Falls	M	4.23	9	2.25	9	.10-.03f	same	....	....	Drawing on surplus	No
Highland Park	M	4.00	8	2.50	10	.07f, .09½g	.05.23f, .07g	56.40	52.36	Inc. consumption., inc. revenue	....
Holland	M	3.60-4.95	9	1.80-2.25	9	.09-3.6f	same	0.0930	0.0583	Drawing on surplus	....
Houghton	M	3.60	9	2.25	9	.12 & 100 per quarter service charge	.25f	73.50	75.22	.....	No
Iron Mountain	P	.45	8	.25	8	.22½-.06f, .30-.08g	same	13.00	13.00	Running behind	No
Jackson	M	3.60	8	....	..	.10f	.750f	20.86	....	Increase in rates	No
Ludington	M	4.00-5.00	8	.30	10	.10f	.10g	5.5	4.5	Raise in rate, curtailing new work	No
Mt. Clemens	M	5.00	9	3.00	9	.13-.08f	.11-.06f	66.02	29.70	.....	....
Niles	M	.50	9	.25	10	1.50-6.3f	....	....	....	Careful management	No
St. Joseph	M	.40	9	.35	9	.35-.20g	.15-.08g	26.00	12.00	Increased rates	No
Sault Ste. Marie	M	3.00	8	2.25	8	.09-.05f	.15-.05g	....	....	Bond issue	No
South Haven	M	4.50	9	.30	9	.16f, .22g	.133f, .18g(j)	8.35	8.41(j)	.....	No
Minnesota:											
Bemidji	P	.35	8-10	.10	8-10	.30-.20f	same	.05-1000g	same	.....	....
Cloquet	M	5.00	10	2.50	10	.09-.50g	same	86.00	....	.....	....
Crookston	P	.40	10	.25	10	.45-.08g	....	....	....	.....	....
Fairmont	M	3.50-4.00	10	2.00-2.50	10	.25-.05f	same	....	....	.....	....
Lake City	M	.35	10	.22½	10	.12½f, 12½g	same	14.80	10.20	By 100% metering	No
Little Falls	P	3.50	10	....	..	.30-.25g	same	....	....	.....	....
Northfield	M	4.00	10	2.50-3.00	10	.15f	.15f	40.29	36.40	Drawing on surplus, cutting expenses	No

METER RATES—FINANCES—LABOR—(Continued)

City and state	Private or municipal	Present wages of common labor	Hours per day	Wages of common labor in 1914	Hours per day	Present meter rates. f-per 100 cu.ft., g-per 1,000 gals.*	Meter rates* in 1914	Operating costs in 1920 per 1,000,000 gals. of water delivered	Operating costs in 1914	Method of meeting increased costs of last three years	Has plant lapsed in condition or capacity because of finances
Minnesota (continued):											
Rochester	M	.55	8	2.50	10	$.30f	$.25f	$75.00	$54.00	Increase in rates & consumption	No
Two Harbors	M	.65	8	.28	9	.07g	.04¼g	27.00	15.00	Increase in rates	No
Wabasha	M	3.50	10	2.00	10	.15g	....	50.00	....	....	....
Willmar	M	.40	9	.35	9	.35-.06f	same	....	....	By increasing output	No
Mississippi:											
Bay St. Louis	P	2.50-3.00	8-9	1.50-2.00	9	....	....	....	....	....	....
Canton	M	2.50	10	3.00	10	.20f	.20f	....	....	Metering & borrowing	No
Corinth	M	2.00	12	2.50	12	.18f, .60-.15g	....	....	....	Advance in rates	....
Jackson	M	2.00	9	1.25-1.50	10	.20-.10f	same	75.00	65.00	Pitometer survey, reducing forces, cutting expenses	Yes
Missouri:											
Aurora	P	.30	10-12	.20-.25	10-12	.25g	.25g	....	....	....	....
Carrollton	P	4.00	8	2.00	10	.50-.15g	.40 .15g	....	....	By motor driving pumps and metering	No
Chillicothe	M	3.20	8	2.00	8	.40-.12g	.50-.20g	85.00	....	....	No
Princeton	M	3.50	10	3.00	10	.40-.20g	.30-.20g	....	....	Cutting force and raising rates	Yes
Trenton	M	.40	8	.20	9	.40f	.30f	....	12.50	Increase in rates	No
Montana:											
Billings	M	5.00	8	3.00	8	.25-.05f	.25-.10f	22.92	11.20	....	No
Bozeman	M	4.00	8	3.00	8	1 min. f-2.40g	....	54.70	....	....	No
Deer Lodge	P	6.00	8	3.00	8	.08-.33g	.08-.33g	....	....	Drawing on surplus, loans	No
Glendive	M	4.50	10	3.00	10	.40f, .15g	$1 per mo.	200.00	150.00(h)	Cutting force	No
Kalispell	M	4.00	8	2.50	8	.50-.05?f, .40-.07½g	same	39.25	36.59	Drawing or surplus, stopping waste	No
Missoula	P	4.50	8	3.00	8	....	....	....	....	Loss of net income	No
Nebraska:											
Aurora	M	.40	10	.25-.35	10	....	....	....	....	By economy	No
Crete	M	.50	..	.30	..	.20g	.20g	11.70	11.70	....	....
Hastings	M	3.60	8	2.40	8	.18f	.14f	68.20	96.10	Increased rates	No
Nebraska City	P	3.60	8	2.00	8	.30g	.25g	99.75	52.50	By borrowing money	Yes
Schuyler	M	4.50	10	3.59	10	.20f, .26 2-3 g	.15f, .20g	195.81	....	Increasing rates & consumption	No
New Hampshire:											
Claremont	M	3.60	9	2.00	10	.15f, .20g	.15f, .20g	34.00	28.00	Gravity system	No
Dover	M	4.00	9	2.00	9	.23-.19f	.23-.15f	8.21	7.78	....	No
Franklin	M	3.25	9	2.00	9	.37½f	.30f	106.00	74.00	Raised rates	No
Lebanon	M	3.50	9	2.00	9	.25-.12½g	same	....	....	....	No
Newport	M	3.50	9	2.00	9	.25-.13½g	.25-.13½g	....	....	Making no extension	No
New Jersey:											
Bridgeton	M	3.00	9	1.50	9	....	....	29.30	24.07	....	No
Cape May	M	.40	8	.35	9	.20g	same	....	....	....	No
Essex Falls	M	4.50	9	2.25	9	.17-.30g	....	....	....	Changing from steam to fuel oil engine	No
Freehold	M	3.60	9	1.75	9	.15f	.15f	130.00	70.00	....	No
Hawthorne	..	5.00	44 per week	1.25(j)	10	.20-.04f	same j	20.00	....	Bond issue	No
Jamesburg	P	1.50	9	2.75	9	.25g	.25g	....	....	....	....
Newton	M	3.75	9	1.25	9	.25-.04g	same	....	....	Drawing on surplus, cutting force	No
Nutley	M	3.60	8	2.50	8	.30f	.375f	364.00	....	Decreasing unaccounted for water	No
South River	M	.45	8	.15	10	.25g	.25g	234.00	377.00	Increase in revenue	Yes
Wallington	M	.50	8	1.75	10	.20f	same	....	....	....	....
New Mexico:											
Tucumcari	M	.50	8	.30	11	.50f	.35f	150.00	120.00	....	....
New York:											
Carthage	M	4.56	9	2.00	9	.36-.06f	.36-.06f	....	....	....	....
Cortland	M	3.20	8	1.75	8	.15f	.15f	45.00	30.00	Revenue from sale of water	No
Dansville	M	2.75	9	1.75	10	.12g	.12g	.0052	.004	Cutting force & drawing on surpl	No
Elmira	M	4.66	8	2.40	8	.30-.06f	same	43.10	27.00	Increasing earnings	No
Glens Falls	M	2.00	8	1.50	8	....	....	37.60	54.06	....	No
Gloversville	M	.50	48-50 week	.70	..	.12-.03¾f	....	....	....	....	No
Homer	M	.40	10	.30	10	.40g	.30g	....	....	By loss	No

METER RATES—FINANCES—LABOR—(Continued)

City and state	Private or municipal	Present wages of common labor	Hours per day	Wages of common labor in 1914	Hours per day	Present meter rates: f-per 100 cu.ft.; g-per 1,000 gals.*	Meter rates* in 1914	Operating costs in 1920 per 1,000,000 gals. of water delivered	Operating costs in 1914	Method of meeting increased costs of last three years	Has plant lapsed in condition or capacity because of finances
New York (continued):											
Hudson	M	3.00	8	1.50-1.75	8	$.05g	$.05g	$25.00	$12.50	Bond issue	No
Jamestown	M	3.20	8	2.00	8	.20f	.15f	39.13	61.46	.....	No
Little Falls	M	3.60	8	2.00	8	....	....	30.00	not metered	Refunding bonds	Yes
Lowville	..	2.50	10	4.00	10	.20f	.20f	3,500 year	....	.....	No
Medina	M	2.80	8	2.00	10	.40-.12g	same	....	....	.....	No
Mt. Morris	M	.35	8	.30	9	.40-.20g	....	13.61	....	.....	No
Mt. Vernon	P	4.50	8	.17½-.20	9	.30-.12f	.30-.10f	....	....	Drawing on surplus	No
Ossining	M	4.00	8	2.50	8	2.00f	1.50f	....	....	Raised rate	No
Peekskill	M	3.30	8	1.75	8	.20f	.10f	80.00	30.00	Loan	No
Salamanca	..	3.00	8	1.75	8	....	....	....	....	Less surplus	No
Scotia	M	.40-.45	8	.25	8	.30f	.20f	72.00	72x20%	Increase in rate	No
Seneca Falls	P	3.60	9	1.50	9	.20-.10f, 26½-13½g	same	22.00	50.00	Deferring interest payments	No
Waverly	M	3.60	9	2.00	9	.30-.06f	same	....	....	Out of earnings	No
Wellsville	M	3.50	8	1.50-1.75	9-10	.225 net f	.27 net g	82.00	44.00	Incr. in rates & drawing on sur.	Somewhat
North Carolina:											
Charlotte	M	2.50	10	1.25	10	.17 1-3f, .23g	.25f, .33 1-3g	140.00	123.00	.....	No
Durham	M	2.50	10	1.50	10	.25g	.25g	.13+	....	.....	....
Goldsboro	M	2.00-2.50	10	1.50	10	.33 1-3-.0843g	same	....	....	By reduction of earnings	No
Henderson	P	4.00	10	1.25	10	.30-.18f	.26-.15f	120.00	80.00	Reducing consumption & waste	No
Kinston	M	2.00	10	1.00	10	.30g	.30g	300.00	190.00	Cutting force & drawing on sur.	Yes
New Bern	M	2.00	10	3.50	10	.25-.08g	same	110.00	130.00	From revenue of wtr. & lt. plnt.	No
Rocky Mount	M	2.00	10	1.50	10	3.00-.20f	2.00-.06f	90.00	60.00	.....	No
Wilmington	M	3.00	10	1.50	10	.16-.096f	....	....	....	City treas. & reducing consumptn.	Yes
North Dakota:											
Enderlin	M	4.50	10	3.00	10	.35g	.35g	200.00	200.00	.....	No
Valley City	M	4.00	10	3.00	10	.35f	.30f	115.97	142.63	Increase in output	No
Wahpeton	M	100 per mo.	8	90 per mo.	12	.23g	.23g	75.00	60.00	Reducing net earnings	No
Ohio:											
Archbold	M	4.00	10	3.00	10	.35g	.30g	....	....	.....	....
Barnesville	M	3.00	8	2.00	8	.50-.75g	.30-.40g	15.00	7.50	Increased rates	No
Bellevue	M	.45	8	.20	10	.30-.05g	same	51.40	39.40	Drawing on surplus	No
Cleveland	M	.60	8	.25	8	.06f, .08g	.04f, .05¼g	46.67	34.15	Bond issue & drawing on surpl.	No
Conneaut	P	4.50	8	3.50	9	.25-.06g	.25-.06g	....	....	.....	....
Dayton	M	.40-.42	8	.25	8	.12-.06f, .90-.45g	.08-.06f, .60-.45g	75.00	46.75	Decreasing force	No
Delaware	P	4.00	10	2.50	10	.30f	.25g	....	....	Borrowing money	No
East Liverpool	M	4.00	8	2.00	8	.66 2-3-.10g	.40-.08f	....	....	Increasing rates	No
East Youngstown	..	4.00	8	4.00	10	.25g	.25g	25.00	17.50	Increased consumption	No
Eaton	M	.40	10	.25	10	.37½g	.23g	....	....	Bond issue & increase in rates	No
Franklin	M	4.00	8	3.00	10	.10-.18g	.07-.15g	....	....	Raising rate	No
Gibsonburg	M	.40	..	.50	10	.35-.25f	....	....	....	Bonds for extension	No
Hidesville	M	4.00	10	1.50-2.00	10	.40g	.25g	....	....	Raising rates	No
Hillsboro	M	4.00	10	2.50	10	1.15-.45g	.90-.35g	....	....	Surplus	....
Lakewood	M	.50	8½-10	.25	8½	.12f	.10f	....	....	Increasing rates, reducing leaks, drawing on surplus	No
Logan	M	3.20	8	2.00	8	.40g	.20g	....	....	Raising water rents	No
Marietta	M	3.20	8	2.00	9	.12-.30g	.06-.30g	....	....	Increasing water rents	No
Martins Ferry	M	3.50	8	3.00	8	.25 domestic .02½-.10 industrial	same	37.90	36.40	Revenue adequate	No
Medina Village	M	.40	8	.35	9	....	½ of present rate	....	1-3 less than present	Advance in rates	No
Middletown	M	.50	8	.25	9	1.25 per 1,000 cu. ft. quarterly	1.00	92.00	....	Bond issue & cutting consumption	No
Napoleon	M	.35	8	.25	10	.25-.10f	.15-.08f	....	....	Raising rates	No
Newark	M	3.60	8	....	..	.18f	.15f	....	....	.....	No
Niles	M	5.20	8	2.00	8	.04½f	.04¼f	35.00	32.00	Water rents	No
Ottawa	M	.40	8	.20	10	1.00f	.10g	200.00	38.00	Funds city treasury	....
Ravenna City	M	.50	8	.25	10	....	....	61.53	25.50	Metering, tax	No
Reading	M	4.00	8	2.50	8	.10-.40f	.06-.20f	....	....	Used surplus & raised rates	Yes
St. Marys	M	.38	8	.25	8	.25f	.15f	600.00	....	Raising rate	No
Springfield	M	.50	8	.17½-.22½	8	.07½-.04½f, .06-.10g	same	29.00	21.40	Drawing on surplus	Yes
Toledo	M	.55-.70	8	.27½-.35	8	.10f	.0675f	58.55	25.20	From water revenues	No
Urbana	M	3.50	..	1.75-2.00	..	.25g	.25g	....	....	Reducing or cutting out new work	No

City and state	Private or municipal	Present wages of common labor	Hours per day	Wages of common labor in 1914	Hours per day	Present meter rates: f=per 100 cu ft.; g=per 1,000 gals.*	Meter rates* in 1914	Operating costs in 1920 per 1,000,000 gals. of water delivered	Operating costs in 1914	Method of meeting increased costs of last three years	Has plant lapsed in condition or capacity because of finances
Ohio (continued):											
Van Wert	M	.45	8	.30	8	$.265f	$.1875f	$80.00	$72.00	Increase in rates	No
Wapakoneta	M	4.00	8	3.00	8	.25-.08f	.20-.04½f	....	....	Drawing on surplus	No
Wilmington	P	4.00	10	2.50	10	.25g	.25g	225.00	200.00	elec. motor driven instead of stm.	No
Oklahoma:											
Altus	M	4.00	8	1.50	8	.25-.17½g	same	....	....	Funds from other depts.	Yes
Hugo	M	3.00	8	2.00	8	.12-.35g	.06-.35f	50.00	35.00	Increasing rates	No
Sapulpa	M	4.50	8	2.40	12	.45g	.25g	....	....	Higher rate	Yes
Tahlequah	M	3.20	8	1.50	10	.50g	....	....	....	Funds from treasury, reducing consumption	
Oregon:											
Hood River	M	4.00	8	2.50	9	.33-.11g	same	....	....	Drawing on surplus	No
Marshfield and North Bend	P	3.60	8	2.50	8	....	....	....	....	Increased volume of business	....
Roseburg City	P	3.50	8	....	..	....	....	....	....	.....	Yes
West Linn	M	4.00	8	2.50	8	.15g	.15g	4.00	2.50	From water receipts	No
Pennsylvania:											
Berwick	P	.40	9	.15	10	.08-.35g	same f	....	....	Keeping expenses down	No
Catasauqua	M	3.00	10	2.00	10	.04-.25f	same	....	....	.....	No
Chambersburg	M	.30-.40	10	.175-.185	10	.10f	.10-5% off f	....	....	Gravity supply, only 2 men	No
Duquesne	M	.50	10	.38	10	.35g	.25g	325.00	300.00	Raise in water rents	No
Erie	M	2.50-2.50	10	1.75-2.00	10	20g	same	32 742	12.89	.....	No
Hamburg	P	4.00	10	2.00	10	.30 down f	same	....	....	Increased consumption	
Hollidaysburg	..	.40	..	.20	..	....	....	....	....	Gravity plant	....
Jersey Shore	P	3.15	9	2.00	10	.25g	.25g	....	....	Increasing rate	No
Lancaster	M	.42	9	.35	9	05g	same	.0613	.05	City treasury & reduction in force	No
Lebanon	M	.30	10	20	10	....	....	30.00	16.00	Surplus	No
Lehighton	P	40	10	15	10	.50-.08g	.25-.03g	....	....	Drawing on surplus cutting force	No
Lewiston	..	4.00	10	1.75	10	.40-.035f	33 1-3-.03f	....	....	Increased revenues	No
McDonald	P	3.00	9	2.00-2.25	9	.35g & $3a quarter, service, charge	.60-.10g	.16	.09	Surplus—increase in rate	Yes
Media	M	.35	9	1.50	9	.20-.10g	.10-.07g	91.82	60.49	Increase in rates	....
Meyersdale	P	3.50	9	2.00	9	.30g	.30g	....	....	Drawing on surplus, cutting force	No
Minersville	P	4.00	8	1.75	9	.20-.06f	same	....	....	No extensions or renewals	Yes
Nazareth Pen Argyl Wind Gap	P	.40	..	.20	..	.06-.20f	.05-.15f	....	....	Cutting down force	No
Rankin	M	5.40	10	3.00	10	.17f	.17f	135.00	130.00	Funds from boro treasury	No
Shamokin	P	4.20	8	1.62	..	.20-.04f	same	....	....	Cutting force, curtailing repairs, improvements, etc	Yes
Sharpsville	M	3.70	8	2.62	8	.30g	.20g	12,000 total	6,000	Boro general fund	No
Stroudsburg	..	.30	10	.20	10	.10f	.10f	....	....	.....	No
Susquehanna, Lanesboro	P	4.50	9	2.70	9	.40-.25g	same	....	....	Careful economy	....
Tyrone	P	4.50	9	1.75	10	.10-.02g	same	16,000 total	5,500	Drawing on surplus	No
Uniontown	..	.40	9	175	10	.25g	25g	....	....	From surplus	No
Wilkinsburg	P	3.78-5.00	9	1.75-2.25	10	.20f	.20f	....	....	Increased consumption	No
South Carolina:											
Aiken	M	1.50	10	1.00	10	.50g	.30g	....	....	Cutting pay & raising rates	No
Charleston	M	2.00-2.50	10	1.50-2.00	10	.185-.045f, .246g	same	76.40	....	From surplus	No
Cheraw	M	1.50	10	1.50	10	.37-.15g	.33 1-3-.10g	100.00	75.00	Increased rates	No
Clinton	M	2.00	10	1.00	10	.40-.10g	.30-.10g	....	....	Increased rates	No
Darlington	P	1.50	10	..	..	30g	30g	....	....	....	No
Easley	M	2.00	10	90-1.10	10	.10-.25g	.10-.25g	....	....	Earnings from plant	No
South Dakota:											
Rapid City	M	5.00	9	3.00	9	3.00 1st 1200f, rest .07½	same	5.00	4.00	Curtailing extension	Somewhat
Tennessee:											
Clarksville	M	2.50	10	1.25	10	....	20% less than pres.	10.00	6.50	Raising rates	No
Dyersburg	M	2.50	10	1.50	10	.30g	.15g	30.00	90.00	From treas. & reduced consumptio	No
Union City	M	2.00	10	1.75	10	....	....	....	....	Raised rates	No

METER RATES—FINANCES—LABOR —(Continued)

City and state	Private or municipal	Present wages of common labor	Hours per day	Wages of common labor in 1914	Hours per day	Present meter rates: f-per 100 cu.ft., g-per 1,000 gals.*	Meter rates* in 1914	Operating costs in 1920 per 1,000,000 gals. of water delivered	Operating costs in 1914	Method of meeting increased costs of last three years	Has plant lapsed in condition or capacity because of finances
Texas:											
Brownsville	M	1.50-1.75	8	1.50-1.75	10	$.30-.15g	same	....	....	From treas. & neglected impvts.	Yes
Dallas	M	3.50	8	2.20	8	.25-.15g	same	$.14	....	Overdraft	No
Galveston	M	110 monthly	8	95 monthly	8	.20f	$.20f	78.98	$93.75	.....	Yes
Hillsboro	M	3.50	8	1.75-2.00	8	.50g	.25g	300.00	180.00	Funds from city treas., over draft	....
McKinney	M	2.50	8	1.75	8	.40-.35g	same	270.00	200.00	Drawing on surplus	Yes
Stamford	P	.40	8-10	.15-.175	8-10	.15-.50f	same	....	....	.....	....
Vermont:											
Fair Haven	M	.50	9	.25	9	1.875f, .25g	same	....	....	Increase in flat rate	....
Northfield	M	3.00	9	4.00	8	.25f	.28f	....	....	By revenue	No
Richford	M	.30	9	.30	10	....	....	....	....	Drawing on surplus	No
Virginia:											
Covington	M	2.97	9	1.50	10	.10g	.10-.05g	....	....	Funds from treasury and cutting down force	No
Martinsville	M	2.50	10	2.00	10	.15 plus 10%g	.15g	44.00	40.00	Funds from city treasury	No
Richmond	M	4.00	9	2.25	9	.09-.06f	.11-.375f	4.50	3.35	From general appropriation	No
Washington:											
Anacortes	..	3.20	8	2.25-2.50	10	....	....	....	....	.....	....
Bellingham	M	.50	8	.50	8	1.00 min. for 400 ft.	100 for 300 ft.	....	....	Economy	No
Dayton	M	3.50	8	3.00	8	1.00-.10g	same	....	....	.....	....
Hoquiam	P	4.40	8	2.50	9	.375-.06f	.30-.05f	....	....	.....	No
Palouse	M	3.50	8	2.40	8	1.25-.25g	1.00g	....	....	Funds from treas., & cutting force	Yes
Pullman	M	4.00	8	2.50	8	1.00-.10g	1.00-.20g	1,300 total	1,300	.....	No
Seattle	M	4.75-5.25	8	3.00	8	.08g	same	59.40	66.985	Increased revenue & greater efficiency	Yes
Spokane	M	5.00	8	3.00	8	.10g	.10g	2.05	1.58	Cutting force & reducing waste	Yes
Walla Walla	M	4.00	8	2.50	8	.75-.08g	same	....	....	.....	No
Winlock	P	3.20	8	2.50	9	.40g	.30g	....	....	Cutting force & extensions	Yes
West Virginia:											
Princeton	P	4.00	10	2.50	10	.50g	.40g	....	....	Drawing on surplus	Yes
Wisconsin:											
Antigo	M	3.00-4.00	10	1.75-2.50	10	.35 max. f	same	....	....	Using surplus	No
Ashland	P	4.00-5.00	10	2.00-2.25	10	.18f	.12f	.065	.049	Increasing floating debt	No
Baraboo	M	3.00	10	2.25	10	.15g	.15g	70.00	60.00	.....	No
Fond du Lac	M	4.50	9	2.75	10	.30f-.40g	same	....	....	Drawing on surplus	No
Green Bay	M	.50-.55	9	.175-2.25	10	.24-.05f	.22-.14	....	....	.....	No
Jefferson	..	.40	10	.25	10	.12f, .16g	same	125.00	191.00	Efficiency in operation	No
La Crosse	M	.45	8	.25	9	.15-.03f	.15-.030f	38.43	21.17	Increased budget & 5% surcharge	No
Madison	M	.40	9	.25	9	.075f	.06f	45.00	37.80	Increased efficiency	No
Milwaukee	M	.50-.70	8	.25-.31¼	8	.07f, .09 1-3g	.04½f-.06g	24.59	15.87	From water rates	....
New London	M	.40	10	.35	10	.20-.12g	.15g	140.00	190.00	Increased consumption and rates	....
Platteville	M	3.00-4.00	10	2.00-3.00	10	.30-.10g	.30-.10g	242.32	235.76	City levy in taxes	No
Stevens Point	P	3.50	8-9	2.00	8-9	.26-.03¾f	same	61.00	28.00	.....	....
Watertown	M	.40	10	.25	10	.16-.04¼f	same	....	....	Increased consumption	No
Wyoming:											
Cheyenne	M	4.00	8	3.00	8	.25-.05g	same	....	....	Funds from city treasury	....
Green River and Rock Springs	P	.485	8	.25	10	1.50-.40g, 1.12-.30f	....	218.00	116.00	Reduced returns on investment	No
Canada:											
Manitoba	M	.60	8	.25	9	.23f	.23f	199.83	238.75	Economy & efficiency	No

*Where rates are on a sliding scale, the highest and lowest are tabulated when reported.

a—For electricity. b—Buy water at 16 cents per miner's inch, sell it at flat rate $1.25 to $5.00 per month. c—Includes operation, distribution, office, fixed charges, taxes, etc. d—Distributing system municipal. e—For year ending Sept. 1. f—Not including interest or depreciation. g—Needed new supply main and increased storage not built. h—1916. j—1915.

NEWS OF THE SOCIETIES

June 6—COUNCIL ON STANDARDIZATION. Hollenden Hotel, Cleveland.

June 6-10—AMERICAN WATER WORKS ASSOCIATION. Annual convention, Hollenden Hotel Cleveland. Secretary, J. M. Diven, 153 W. 71st st., New York City.

June 7-10—KENTUCKY STATE ROAD ENGINEERS. Annual convention. Armory, Louisville, Kentucky.

June 10—ROCHESTER ENGINEERING SOCIETY. Annual meeting. Election of officers. Rochester Engineering Society Rooms.

June 13—AMERICAN FEDERATION OF LABOR. Albany Hotel, Denver, Colo.

June 13-14—CLEVELAND SECTION AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Regional meeting Great Lakes Territory. Hotel Statler.

June 14-16—NATIONAL FIRE PROTECTION ASSOCIATION. Annual meeting. San Francisco.

June 15-17—LEAGUE OF MICHIGAN MUNICIPALITIES. Annual Convention. Kalamazoo, Mich.

June 17—PHILADELPHIA SECTION AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Outing at Howard McCall Field.

June 17—INLAND EMPIRE SECTION AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with engineering societies of Spokane.

June 20—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Salt Lake City.

June 20-24—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. 13th semi-annual meeting. Detroit, Mich.

June 20-24—AMERICAN SOCIETY FOR TESTING MATERIALS. Annual meeting. Asbury Park, N. J.

June 28 — ATLANTA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Election of officers. Georgia School of Technology, Atlanta.

June 28-July 1 — SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION UNIVERSITY OF PITTSBURG. Annual convention New Haven, Conn.

July 15—NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Annual meeting. Crown Hotel, Providence, R. I.

Aug. 10-12—INTERNATIONAL ASSOCIATION OF STREET CLEANING OFFICIALS. Annual conference. Hotel La Salle, Chicago, Ill.

Sept. 28 (10 days)—NEW YORK ELECTRICAL EXPOSITION. Seventy-first Regiment Armory, New York City.

Oct. 11-14—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual Convention, Atlanta, Ga. Hotel Ansley. Secretary, James J. Mulcahey, Municipal Building, Denver, Colo.

Oct. 24-28—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Southern Hotel, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Nov. 14-18—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

ROCHESTER ENGINEERING SOCIETY

At the annual meeting of the Rochester Section of the American Institute of Electrical Engineers in the Eastman building, University of Rochester, May 27, Dr. John R. Murlin, head of the Physiological Department, University of Rochester, gave a talk and demonstration on the uses of electricity in physiology and medicine. Dr. Henry D. Clough demonstrated the electro-Cardiograph.

COUNCIL ON STANDARDIZATION

The Council on Standardization, which was established at Montreal in 1920, will hold a meeting at 4 p. m., June 6, 1921, at The Hollenden, Cleveland, to which all interested in its work are invited. It is proposed, tentatively to work at present through a number of regular committees composed of specialists, who will report on important current developments in fifteen classified subjects that have been carefully selected, namely, 1, Standard Methods of Water Analyses; 2, Electrolysis; 3, Standard Form of Contract; 4, Standards for Satisfactory Drinking Water; 5, Practical Ranges in Load Factors for Purification Plants; 6, Colloidal Chemistry in Relation to Water Purification; 7, Trade Wastes in Relation to Water Supply; 8, Methods and Records of Water Waste Control; 9, Testing of Water Works Materials and Supplies; 10, Essential Data for Water Department Records and Reports; 11, Practical Standards of Rules and Regulations of Relations Between Water Works and Consumers; 12, Steps Towards Standardizing Stated Quantities for Slides in Meter Schedules; 13, Watershed Protection; 14 Pumping Station Betterments; 15, Standardization of services. George W. Fuller, Chairman; Frank A. Barbour, Edward Bartow, George A. Johnson, George C. Whipple.

NATIONAL CONFERENCE ON CITY PLANNING

The 13th national conference on City Planning was held on May 9-11 at Pittsburgh, and was attended by some 200 persons from outside places. Meetings were held jointly with the Civic Club and the Real Estate Board of Pittsburgh.

Zoning in general was discussed by Robert H. Whitten and Herbert S. Swan, and the proposed zoning ordinance for Pittsburgh was outlined by U. N. Arthur and J. M. Clark. Next James D. Hailman described the recommendation of his committee for major street plan, and A. S. Tuttle spoke on "The Enforcement of a Street Plan." County Planning was discussed and advocated by W. Donley. Another important matter considered was the Distribution of Population, which was discussed by J. R. Ribbins and H. M. Brinckerhoff, the latter dealing with the distribution of the homes of employees of the larger industries. There were also two papers on River Transportation, by Major J. Franklin Bell and Kenneth C. Grant. Aerial Transportation was considered by John Hilder, and Aerial Photography reported on by E. P. Goodrich and Herbert S. Swan. The meeting was closed by John Nolen, who advocated an official planning commission with adequate powers and responsibilities.

Lawson Purdy, of New York, was elected president; George B. Ford, vice-president, and Flavel Shurtleff, of Boston, was re-elected secretary.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS

At the annual [illegible] the American Institute of Electrical Engineers, held in New York on May 20, the following officers were elected for the administrative year beginning August 1: President, W. Rice McClellan; vice-presidents, Walter A. Hall, N. W. Storer, William A. DelMar, [illegible] G. Adsit, John C. Parker, F. W. Springer, H. W. Eales, Robert Sibley, O. B. Coldwell and F. R. Low[illegible] managers, A. G. Pierce, R. B. Williamson, Harlan A. Pratt; treasurer, George A. Hamilton; and secretary, F. L. Hutchison.

DETROIT ENGINEERING SOCIETY

The Detroit Engineering Society held its last meeting of the season on May 20, when Mr. Galusha and Mr. Clarke, of Dwight P. Robinson Co., New York City, gave a talk on "A Mine Mouth Super-Power Station." The meeting was held jointly with the Detroit section of the American Society of Mechanical Engineers and the Detroit-Ann Arbor section of the American Institute of Electrical Engineers. The following officers were elected at a recent meeting of the society: President, M. W. Taber; first vice-president, J. R. McColl; second vice-president, A. L. Trout; and secretary-treasurer, O. H. Dawson.

CANADIAN GOOD ROADS CONVENTION

The eighth annual convention of the Canadian Good Roads Association was held on May 10-12 at Halifax, and was attended by nearly 200 delegates, representing eight of the nine provinces of Canada. The most important discussions centered around the subject of federal aid for highways, and a keen enthusiasm for better highways resulted in suggestions for amendment. Many valuable technical papers were presented, and an instructive exhibit of road making machinery added to the interest of the meeting.

AMERICAN SOCIETY OF SAFETY ENGINEERS

A meeting of the American Society of Safety Engineers was held May 27, at 8 p. m., in the Engineering Societies Building, 29 West 39th street, New York City. The topic was "Electrical Hazards and Their Safeguards." Papers were presented on "High Tension Electric Generation and Transmission," illustrated by lantern slides, by Messrs. C. O. Van Dannenberg and W. W. Samuels. On "Electrical Hazards—Terminal Equipment of the New York Central Railroad Entering New York City," by H. S. Balliet, and on "Small Motor Problems and Industrial Control," by L. E. Smith (this paper was illustrated by lantern slides).

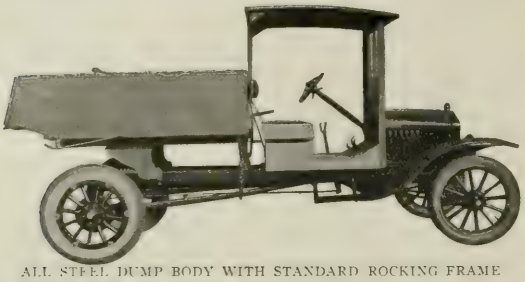
NEW YORK SECTION AMERICAN SOCIETY OF CIVIL ENGINEERS

At the annual meeting May 18 an address was made by Nelson P. Lewis on "What Does the New York Metropolitan District Mean?"

The following officers were elected: President, Nelson P. Lewis; secretary, J. P. J. Williams; directors, Charles Gilman and Joseph J. Yates.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



ALL STEEL DUMP BODY WITH STANDARD ROCKING FRAME

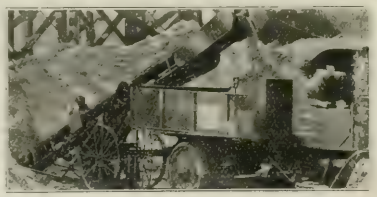
ANTHONY DUMPING EQUIPMENT

The dumping bodies manufactured by the Anthony Co. were first designed for, and appeared co-incident with, the Ford truck. They are now built in different styles for different construction and municipal services.

The All-steel body is supported near the center of gravity on elevated rockers operating near the rear end of the platform of a Ford truck chassis. The load is thus balanced, is easily and quickly dumped by the operation of a lever at the driver's seat. The standard rocking frame provides great interchangeability for all body types, there is no heavy machinery involved, and the large dumping angle insures instant and clean disposal of the load. The bodies are strong and light and can easily be arranged with an adjustable tail gate allowing them to discharge a load of crushed stone or other material continuously as the truck proceeds, so as to place a uniform thickness of top dressing for road construction. The bodies can also be provided with swinging partitions so that they can serve as batch boxes for loading the skips of concrete mixers with measured cement and aggregate for road and pavement work. A special type of box has been put on the market for handling garbage and is provided with a top cover that is raised and the tail-gate opened when the body is elevated 50 degrees to the dumping angle.

THE BROWN PORT-A-BELT

The Brown Port-a-belt is made in 8 standard sizes, including two widths of belt to be used for loading and unloading cars and for loading wagons and trucks, reclaiming piles, delivering into bins and for similar purposes It is used mounted on a pair of wheels for convenient removal from place to place or suspended from overhead, and can be used singly or in series. The belts, which are 12 or 16 inches wide, are run at a speed of 200 feet per minute. They are equipped with either high, low or medium flights, according to the kind of material handled. They are made with lengths end to end of the belt, of 14 to 29½ feet, and maximum height of delivery of 6 to 15 feet. The motors of of 1½, 2 or 3 h. p., and the approximate weights of the machines with motors vary from 1,325 to 2,410 pounds. The belt is provided with sheet steel flaring side guards, increasing its capacity and is raised or lowered in 35 seconds by an enclosed worm gear operated by a crank.



CONVEYOR LOADING FROM STOCK PILE TO WAGON.

CONVEYOR LOADING FROM CAR TO WAGON

BLAW FORMS

Forms for every variety of concrete construction are made by the Blaw-Knox Company and described in catalog 23. All are made of steel and are collapsed mechanically.

Half round forms are interchangeable for arch and invert work and 75 linear feet are required for maintaining a uniform progress of 50 feet per day. Horseshoe forms are of two classes, made either telescopic or non-telescopic, for continuous or for alternate block construction. Full-round forms are manufactured in sections 5 feet long and made in sizes 36 inches to 144 inches in diameter. Each section is made in four or more pieces with joints in a horizontal plane, one of which is a wedge shape key. The forms are absolutely rigid and provide for perfect alignment.

Tunnel forms are made for railroad work where traffic is maintained and where traffic is not maintained, for waterway tunnels of horseshoe or circular shape and for miscellaneous tunnels. All railroad and horseshoe tunnel forms are provided with an integral traveling device and the form is collapsible but non-telescopic. When the form is telescopic a separate traveler is used.

Blaw-Knox tunnel liner plates take the place of wood siding, poling boards, segmental lining and built-up plates in soft ground work to support the natural arch of the ground while the permanent lining is placed. Blaw forms for subways are designed to suit the requirements for special occasions. The Blaw forms for heavy walls are cantilever and gantry type, some of which travel on integral frames. Heavy wall forms are designed to require few or no tie rods, thus promoting economy of construction. Special wall forms have been designed to eliminate cofferdam construction for subaqueous work. Forms for bridge piers are made with Blaw-Knox combination lagging which consist of 12 x 16-inch heavy reinforced plates with vertical liners and horizontal walers, so arranged that they can be fastened together permanently to form units of any size required.

Steel centering trusses are provided for concrete arches with clearance underneath for maintaining traffic and

for supporting the work over rivers and other places where falsework cannot readily be built.

Traveling floor forms are used on flat slab floors; beam and girder forms on groined arches may be made to allow for as much as 8 to 10 feet variation in height. Blaw forms are also designed for light walls and foundations and a complete system has been developed for concrete roads and highway and pavement construction for curbs and the like. The catalog us profusely illustrated with half-tone engravings of progress pictures showing the forms in service on important work.

and installing them, and of the structures made with them. Particularly of cofferdams, retaining walls and the like. It reflects great credit on the Steel Sheet Piling Department which produced it, and is of high value as a hand-book of sheeting and cofferdam construction, giving the principal features of important precedents, illustrated by numerous halftone and line engravings that, with the well-prepared descriptive text, give data of great value to engineers, superintendents and contractors and architects. It has 160 8 x 10½ pages, printed on heavy glazed paper with embossed stiff paper covers.

Among the numerous important works described where steel sheet piles were used are the Tunkhannok viaduct, the 46th Street pier, New York, the Blackrock shiplock, Buffalo, the cofferdam for the raising of the battleship *Maine*, installations for the New York State barge canal and for the United States government, besides a great number of bridge piers, foundations, retaining walls and other difficult and important structures. Devices for handling, assembling, driving, pulling and straightening, methods of driving and bracing, and many other practical features are very clearly presented.

The different sizes, weights, and styles of the Lackawanna steel sheet piles are listed and their essential features and uses are described, tables of their properties are given, concrete protected steel sheeting is described and illustrated and tests of the interlock are illustrated.

SURFACING 36 MILES OF ROAD IN ONE DAY

DUPLEX HIGHWAY GRADING

In road maintenance it has been usual to frequently operate two-blade graders, tandem, hauled by a tractor, dressing first one side of the road and then the other. Recently, however, an innovation has been reported from Park county, Wisconsin, where the outfit of Commissioner Moore, of Janesville, completed thirty miles of road maintenance per 10-hour day with a pair of Stockland quick lift graders with 8-foot blades, hauled side by side by a 10-ton Holt tractor.

The tongues of the graders were attached to the rear of the tractor, making equal angles with the axis of the road and the graders were operated in the usual manner by men mounted on them and controlling the hand wheels that shifted the blades as necessary. When the outfit crossed bridges too narrow for the graders to pass side by side, they were towed tandem, using the wire ropes shown in the background for tow lines. In order to finish the crown of the road after the graders had passed, and to leave a smooth, even surface from shoulder to shoulder, a small drag can be hauled behind the graders to cover the area between the blades of the machines.

LACKAWANNA SHEET PILES

Bulletin 109 of the Lackawanna Steel Co. is much more than an ordinary catalog; it is a well-conceived, admirably prepared and suitably executed monograph, covering the state of the art of steel sheet piling; showing the principal qualities and characteristics of interlocking steel piles, giving ample illustrations of the methods of handling

BARBER-BREEN SNOW LOADER

A circular issued by the Barber-Green Company, Aurora, Ill., describes the successful use of a portable electrically driven snow loader operated on the belt conveyor plan in Chicago with an efficiency of about 3 yards per minute. Photographs, diagrams, specifications are given.

AUTOMATIC LOWERING JACK

The Duff Manufacturing Co. is distributing its new bulletin, No. 308, which illustrates and describes their line of automatic lowering jacks. This type of jack, which is made in a wide variety of heights, is widely used by contractors for raising loads of any kind where a lifting capacity of 25 tons or less is required.

ROAD SUPPLY AND METAL CO.

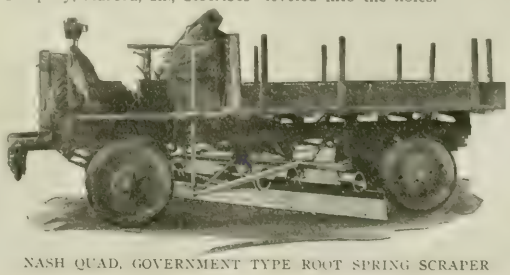
This company supplies wire bar-ties for connecting reinforcement steel rods together and also furnishes tying tools with which one man can make a tie in two seconds. By the use of the specially prepared ties which have loops at each end, and are sold by the 1,000, it is claimed that a great economy of time and labor is effected.

ROOT SPRING SCRAPERS

Spring scrapers manufactured by the Root Spring Scraper Company are patented machines that have been thoroughly tested and have seen severe service on all kinds of dirt roads. They are designed for rapid operation and will handle gravel at a speed of 10 to 15 miles per hour and snow at a speed of 35 miles per hour, doing better work the faster they go, and throwing the snow so far away as to prevent the formation of windrows.

The scraper has a 10-foot blade of high carbon spring steel, with a 2 x 1¼ inch oil tempered cutting edge which can be reversed, doubling its life. The scraper is mounted on heavy springs to resist the stress of high speed and is set at an angle of 45 degrees and operated by a double ratchet wheel and chain. When the scraper is out of commission the truck can be used for any other purpose. It is claimed that the scraper will cover six times the surface of any machine now in use for smoothing city streets.

The same company manufactures also a self-sharpening scarifier with long teeth projecting at both ends so that it can be used either side up and can also be hauled by attachment to any side or corner. It is hooked to the rear of a truck and loosens the road surface so that the gravel can be leveled into the holes.

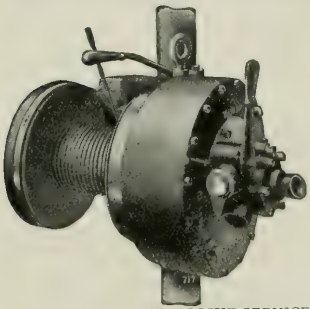


NASH QUAD, GOVERNMENT TYPE ROOT SPRING SCRAPER

WAUGHOISTS

Waughoists, manufactured by the Denver Rock Drill Manufacturing Co., consist essentially of a small enclosed rotary engine geared to the shaft of the hoisting drum and forming a very light, compact and efficient portable hoist that can be attached to a girder, column, derrick mast, gantry, wall bracket or any other convenient support and is recommended for rapid light service and efficiency for all sorts of construction and industrial work where compressed air is available.

The principal parts of the hoist are the motor, the engine, motor housing, distributor, cylinder blocks, spider shaft and piston. The whole engine revolves in the motor housing where an air tight casing protects the engine and serves with an oil reservoir. As the engine is perfectly balanced there is no vibration and it can be instantly reversed by simply pushing the control lever to the opposite position. It has the splash



PORTABLE HOIST FOR LIGHT SERVICE

system automatic lubrication and is operated at high speed geared down 27.5 times for most efficient service. The horsepower is unusually great in proportion to the size and weight of the hoist. It has a brake horsepower of 5 at 100 pounds air pressure, and a capacity of 500 to 2,000 pounds hoisted vertically at the rate of 68 to 148 feet per minute. The drum has capacity for 1,000 feet of ¼-inch rope or 225 of ½-inch rope. It is supplied with 1½-inch air hose; its dimensions are 24½ x 19½ x 17½ inches, and its weight is 335 pounds.

LADDER TYPE STANDARD EXCAVATOR

This machine described in bulletin 4-X of the Pawling & Harnischefeger Co., is suited for heavier and deeper work than that of the wheel type machine and is recommended for depths to 20 feet. It has a well braced steel car body, mounted on caterpillar traction and equipped with a four cylinder vertical motor of the tractor type designed for continuous service and burning either gasoline, kerosene or distillate. The motor is gear connected to the machinery and is cooled by a water radiator. The main clutch is of the friction type and adjustable for heavy or light work or to overload or excessive shock. The double boom is of the box girder type with cast steel buckets having tool steel teeth. Corduroy tractors are driven by chains and easily dismantled for repairs. The belt conveyor is chain driven and delivers earth to either side of the machine. Its bearings exclude dirt and are lubricated by independent grease cups.

The standard depth of cuts are 8, 10, 12 and 22 feet. The width cut varies from 51 to 76 inches with the different machines. Six speeds are provided on all machines and vary from about ¼ to 3¼ feet per minute.

One of these machines averaged 500 feet per day of trench 9 feet deep and 27 inches wide. It made a record of 800 feet of this trench in one day, at a total cost of $7 for labor, $1.80 for fuel and 50 cents for lubrication.

INDUSTRIAL NOTES

The Post Tractor Company, of Cleveland, Ohio, and the Whitney Tractor Co., of Upper Sandusky, Ohio, have consolidated as the Post-Whitney Company, of Cleveland.

The Austin-Western Road Machinery Co., of Chicago, is now located at 400 North Michigan avenue.

The third annual convention of the National Lime Association will be held at Hotel Commodore, New York City, June 15, 16, 17. A number of technical, industrial and commercial papers will be presented, including one on "Problems to be considered in changing a quarry from hand method to steam shovel method," by Irving Warner, and one on "Wet mixed lime mortar," by W. C. Hay. A discussion will also be held on "Is the Central Mixing Plant the Next Step in Handling Lime and Concrete Mortars?" Exhibits will be made by the National Association and by the Eastern Bureau and there will be lunches and an evening banquet, with speeches, music and entertainment.

A 5-ton Federal truck in one day recently hauled a boiler to an elevation of 5,000 feet in the Sierra Nevada mountains under conditions that would have required a 28-mule team for three days. In some places there were 20 per cent up-grades and dangerous sharp turns and it was sometimes necessary on steep down grades to cut down and drag behind a good size tree for an additional brake.

The New Jersey State Highway Department announces the removal of its Northern Division Construction Office, Roy Mullins, Division Construction Engineer, from 790 Broad street, Newark, to 402 Broad street, Newark. The Bridge Division Office will remain at 790 Broad street.

H. M. Davison was from 1903 to 1919 with the Hayward Company, manufacturers of orange peel, clam-shell, electric motor clam-shell and drag scraper buckets, and for two years just past was general sales manager for the Ohio Locomotive Crane Co. He has again become associated with the Hayward Company and will hereafter be connected with the management of that company. Among other duties he will have the general management of sales.

PERSONALS

Sanborn, J. F., consulting civil engineer, announces the removal of his office to 50 Church street, New York City.

Sarr, Frederick, has been appointed first deputy highway commissioner, New York State Highway Department, and Hotchkiss, H. G., has been appointed second deputy commissioner.

Kimball, S. Dexter, dean of the College of Engineering of Cornell University has been nominated president of the American Society of Mechanical Engineers.

Victor T. Goggin, recently New England sales manager of Fred T. Ley & Co., Inc., of Springfield, Boston and New York, has severed his connection with that concern to associate himself as contracting engineer with Dwight P. Robinson & Company, Incorporated, of New York, Chicago, Dallas, Youngstown, Los Angeles and Montreal.

Long, Bayard A., has been appointed sanitary engineer of Johnstown, Pa., to succeed H. J. Baum, who resigned.

Loewenstein, Jacob, for 18 years with the American Bridge Company, is now engaged as consulting engineer, specializing in the purchasing of steel for buildings, bridges and other structures. His offices are in the Equitable Trust building, New York City.

McKee, Wood, of Paterson, N. J., formerly state senator, has been reappointed to the North Jersey District Water Supply Commission by Governor Edwards, of New Jersey.

Daley, Patrick A., who for 39 years has been in the employ of the Water Division of Beverly, Mass., completed this service on April 18.

Herbert, H. D., has been elected borough manager of Carlisle, Pa.

Kaines, John, has been appointed superintendent of highways of the Onondaga Indian Reservation by the New York State Highway Department.

Wright, George C., for eleven years with the Monroe County, N. Y., engineer's office and since 1914 deputy county superintendent of highways, has been appointed county superintendent of highways of Monroe county, N. Y.

Crowley, William T., has been appointed city engineer of Lock Haven, Pa.

Anschutz, H. E., formerly with the Georgia Highway Department, has been appointed engineer of the city planning commission of Atlanta, Ga.

Hunt, E. G., has been appointed city engineer of Aberdeen, Wash.

Greene, Major-Gen. Francis V., police commissioner of New York in 1903 and from 1904 to 1915 president of the Niagara, Lockport & Ontario Power Co., died on May 15 in New York City.

TUNNEL ENGINEERS APPOINTED

The New Jersey Interstate Bridge and Tunnel Commission has appointed George W. Wells, St. John Clark and Col. George L. Watson engineers for the vehicular tunnel under the North river, from the Borough of Manhattan, New York, to Hoboken, N. J.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Municipal Journal and Engineer, Inc.
Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879

Vol. 50 JUNE 11, 1921 No. 24

Baltimore Waste Disposal Report

Burial, reduction and hog feeding have been tried in succession and now a permanent plant is considered necessary. In his report, Chief Engineer Perring discusses the various methods and their suitability for Baltimore conditions.

The city of Baltimore has, during the past forty years, tried various methods of disposing of its garbage, but has found each in its turn to be unsatisfactory. The latest attempt prior to the existing temporary arrangement, was the entering into a contract with the American Feeding Company to dispose of the garbage by feeding to hogs, this contract going into effect on May 1, 1919. The city delivered the garbage in scows at Graveyard Point and the contractor paid the city for each ton a sum equal to 3½ times the price per pound of live killing hogs on the Chicago market. About January 15 of this year, the American Feeding Company removed its hogs from the farm and abandoned the contract, the city retaining the pens, feeding platforms and railway tracks which the company had built on the farm (which land was owned by the city) to satisfy a claimed indebtedness of about $15,000.

Following this, the city made a temporary arrangement to deliver the garbage on scows to a contractor who pays the city $40 per scow load of approximately 180 tons and sells the garbage to farmers for fertilizing purposes. As the towing and handling of garbage costs the city about $90 per scow load, the city loses about $50 per load or 25 cents to 30 cents per ton in addition to the cost of collecting the garbage and delivering it to the scows. This contract expired April 15.

During the year 1920 the total garbage removed by scows from the water-front dumping station was reported to be 130 scow loads, amounting to 24,269 tons. The city owns and operates eleven scows, five of them 92 feet long by 28 feet wide by 12 feet deep, with a capacity of about 400 tons; five scows 80 feet long by 24 feet wide by 12 feet deep with a capacity of 300 tons, and an eleventh scow of about the same capacity as the smaller size but of a different shape. The larger scows cost the city $8,600 apiece, and the smaller scows $6,000.

As for ashes, the city has used these to great advantage in filling in low land and thus making many acres of valuable building land in the city, although the dumps have been more or less of a nuisance because of careless maintenance. The street cleaning department reported for the year 1920 that it collected 43,000 cubic yards of mixed ashes and rubbish at a cost of $369,704, and it is estimated that the ash collection cost $1.27 a ton and the rubbish collection $5.02.

In view of the necessity of making some permanent arrangement for disposing of the garbage, Mayor Broening asked H. G. Perring, chief engineer of the Department of Public Improvements of Baltimore, to report on the most feasible method of disposing of the city's garbage and, under date of April 9, Mr. Perring submitted a report, of which an abstract is given herewith.

In considering the subject, attention must be given to: "(1) The danger to health through the possible bearing of infectious and contagious diseases in city wastes; (2) the possible spread of rats, mice, flies, mosquitos and other vermin; (3) the producing of annoying and foul odors, either for long-continued periods or even for short stretches of time; (4) unsightliness; (5) that intangible, psychological effect which has to do with the self-respect of persons who object to living near a dump or near any place where the city disposed of its wastes.

"In arriving at a solution we must not only consider the residents of our city, but we must also be on good terms with our adjoining neighbors in the state and must not do anything that will create a dangerous or offensive condition to them."

The largest part of the expense connected with city waste is that of the collection of them and, from a financial viewpoint, the actual ultimate disposal is of relatively small importance.

Baltimore has reached the size where it must decide upon some permanent method, the cost of any plant for disposal being now too great to permit of further experimentation. The necessity for immediate action, however, is not so urgent as many think. The city owns a farm just across the creek from the land used by the

American Feeding Company, which farm contains 157 acres of nearly level land with sandy soil and a 300-foot wharf. There is no question in Mr. Perring's mind that the garbage of the city can be disposed of for a year or more in a perfectly sanitary manner by hauling it to this city farm and burying it in trenches. He is confirmed in this opinion by Dr. John H. Gregory, of Johns Hopkins University, who used this method of disposing of the city garbage of Columbus, Ohio, for four years prior to the installation of the reduction plant by that city. From 1882 to 1901 Baltimore disposed of its garbage by spreading it over the ground and plowing in (but presumably not in the sanitary method contemplated by Mr. Perring). From 1902 to 1919 the garbage was disposed of by the reduction process under two different contracts, and during the early part of 1919 it was again disposed of by burial in trenches 18 inches deep by 5 feet wide, a 12-inch layer of garbage being covered with 6 inches of soil

RECOMMENDED METHODS OF DISPOSAL

The greater part of this report is devoted to a consideration and comparison of the various methods which seemed to be practicable for Baltimore, these including hog feeding, reduction, incineration, fuel briquetting and utilization for stock feeding. Summing these up, Mr. Perring concludes that the cost of disposing of garbage, rubbish and ashes, including collection, should not exceed $1.25 per capita per year, while 35 cents is already being paid by the citizens for removal of ashes. He recommends that the householders be required to make careful separation of the wastes into ashes, rubbish and garbage; that the ashes be used for filling streets and low lands, that rubbish be burned in four incinerators, each containing two 15-ton units, to be built in convenient parts of the city, saleable material being salvaged at these plants; and that garbage be removed to a single reduction plant. Ashes would be collected twice a week in the outlying districts and more frequently in the congested districts, rubbish would be collected once a week, and garbage would be collected daily from April to October and three times a week from October to April.

The garbage should be removed quickly to relay stations, and thence to a reduction plant by truck and trailer, by trolley, railroad, scow or other means. The reduction plant should have a present maximum daily capacity of 300 tons and should be built in one or two localities, either near existing fertilizer factories or near the sewage disposal plant. The city should endeavor to collect every pound of garbage and under no circumstances permit collection by private parties. It should own and operate its collection equipment and disposal plant. No storage of garbage for more than one day should be allowed at any point. If scows are used for removing the garbage, they should make trips to the disposal plant each day, even though but partly loaded. He recommends that the use of truck and trailer in garbage and waste collection be carefully investigated; in fact, that the whole system of collection be studied carefully with a view to reducing the cost.

Collection of refuse from houses in the outlying sections is unduly expensive and in many cities is largely neglected. It is recommended that houses built in the outlying sections of Baltimore be required to be equipped with some form of individual incinerator for garbage and rubbish.

He estimates the cost of a 300-ton reduction plant as $1,000,000, and of the four incineration plants as $180,000, this cost including the sites and engineering as well as the plant, buildings, etc.

Meantime, while the method of final disposal is being decided upon and the plant constructed, the garbage should be taken to the city farm and buried under the following conditions: The scows should not be held at the loading wharf more than 24 hours; the garbage on the scows should be covered with land plaster and disinfectant; the scows should be properly cleaned at the discharging end of each trip. The garbage should not be stored at the farm but should immediately be buried in trenches and covered with 6 inches of earth or sandy loam after being spread with land plaster. If this temporary disposal be performed by contract, the contractor should give an adequate bond and the contract should be revocable by the Board of Awards if sanitary conditions are not maintained, and regular inspection should be made by the street cleaning department to secure such conditions. The city should have power to correct sanitary defects at the expense of the contractor without annulling the contract, within 10 hours after notification of the contractor to remedy the condition and his neglect or refusal to do so. The contractor should be allowed to remove any fertilizer produced by decomposition of buried garbage, if the same can be done in a sanitary manner, within one year after the termination of the contract.

HOG FEEDING

In considering the various methods available, Mr. Perring assumes that, if hog feeding be adopted, the city would require 15,000 hogs to consume about 150 tons of garbage a day; that each hog would gain an average of one pound a day in weight and would be sold as soon as it had gained 100 pounds. The interest for 100 days on the plant and equipment would average 29 cents per hog, the fixed charges would be $5, the labor of feeding $1.50, loss through death (estimated at 10 per cent of the herd) $1, a total of $7.79 for producing 100 pounds of pork. If this sold at 10 cents a pound the net return would be $2.21. If 20 pounds of garbage will produce a pound of pork this would give a net return of $2.21 per ton of garbage; or the return would be 88 cents if it required 50 pounds of garbage per pound of pork. As it cost the city last year 50 cents a ton to barge the garbage from the water front to the piggery, and $5 to collect and haul it to the water front, this would give the net cost per ton $4.62.

"As success in operating a piggery depends on good management and prompt delivery of the garbage in a fresh state, it is doubtful whether as

good results as above indicated would be obtained from hog feeding by city employees. Under the contract recently abandoned by the American Feeding Company, which provided for their payment to the city for each ton of garbage delivered to the piggery a sum equal to 3½ times the price per pound of live hogs in Chicago, the theoretical cost to the city for collection and disposal was" $5.22, which includes $5 for collection, 50 cents for transportation and 7 cents for interest on the city's investment at the plant, less 35 cents paid to the city by the contractor on a basis of pork at 10 cents a pound in Chicago. "These theoretical figures have not been realized and, in fact, the city has received no return but has been placed at considerable expense due to the failure of this method of disposal from various causes. Returns from hog feeding are altered vitally by a drop of a cent or two in the price of live pork between the time the shoats are purchased and the time when the fattened hogs are sold.

Hog feeding, if successfully practiced, requires the careful selection of the richer grades of garbage and the rejection of the remaining portions. Whether or not this is done, the hogs themselves will reject considerable quantities of the green garbage and all of the rejected matter must be disposed of by incineration, burial or otherwise. A disadvantage in the case of Baltimore is that the state of Maryland Live Stock Commission has ruled that it will not permit the use of garbage as a feeding material without it is first sterilized, although many authorities claim that sterilizing garbage before feeding to hogs is inadvisable.

The most important arguments for hog feeding were those of patriotism and financial returns, neither of which apply now that the war emergency conditions have passed.

DISPOSAL BY REDUCTION

It is estimated that a reduction plant sufficient to dispose of Baltimore's present garbage would cost between $750,000 and $1,250,000. Assuming $1,000,000, with 15 per cent for interest and depreciation, and that 53,000 tons of garbage would be reduced per year, the fixed charges per ton of garbage would be $2.83. It is estimated that the operating costs would include $2 per ton for labor, $1 for fuel and 40 cents for gasoline, or a total of $3.40 per ton for operating costs, or of $6.23 for both overhead and operating costs.

Assuming a yield from a ton of garbage of 45 pounds of grease at 4½ cents a pound and 220 pounds of tankage at $5 a ton gives a total return of $3.13 or a net cost of reduction of $3.10; to which should be added $5.50 for collecting the garbage and bringing it to the plant by barge—a total of $8.60.

Mr. Perring stated that the garbage reduction plant in Philadelphia is operated without nuisance within three miles of the city hall and within one mile of a fine residential section.

INCINERATION

To burn the garbage, either fuel or combustible waste must be used. If the latter is used, there should be about 30 per cent of combustible waste to 70 per cent of garbage. Investigation in [illegible] and 1915 of the relative quantities and ca[illegible] values of the garbage, ashes and rubbish collected in the city of Washington at different [illegible] sons of the year indicated that the summer production of combustible wastes would not be sufficient to incinerate the summer garbage. If the same condition obtains in Baltimore, it would be necessary to store part of the winter wastes for use in the summer or else to burn coal during the summer months

If incineration is employed, it is recommended that four plants with a combined daily capacity of 250 tons, be located at different parts of the city to reduce the length of haul to a minimum. Their cost is estimated at $375,000. Interest and depreciation on this at 15 per cent give fixed charges of $1.06 a ton, while operation is estimated to cost $1.20 for labor. 30 cents for fuel (used during four months) and 24 cents for disposal of residual ash and clinker (at $2 a ton and ash equaling 12 per cent of matter consumed). This gives a cost of incineration of $2.80 per ton of garbage. In addition, the cost of hauling refuse to the incinerators would probably be 50 cents a ton less than hauling it to the water front, giving a total cost of $7.30 a ton, as against $8.60 for reduction and $5.22 for hog feeding. It is to be noted that this method provides for the disposing of all the rubbish and garbage collected by the city.

"Disposal by incineration as outlined above involves the erection and operation at convenient points within the city of four plants. Residents in these neighborhoods and owners of near-by property would object to the idea of garbage disposal plants being placed in their midst. Even if the stacks emitted no odors, the constant passing to and fro and dumping of garbage wagons would be a disagreeable feature not entirely imaginary."

If a single incineration plant were built at a location similar to that for the reduction plant, there would be a longer haul for both garbage and the refuse required to burn it, and it is estimated that there would be added to the cost about $1.50 per ton of garbage, making the cost of collection, removal and disposal $8.80 a ton as against an estimated cost of $8.60 for reduction.

OTHER METHODS

Quite a few houses in Baltimore are equipped with individual incinerators for burning both garbage and rubbish, which seem to operate satisfactorily and with no nuisance. To equip the whole city with these would cost about $10,000,000. If the city paid for the whole equipment, the ultimate cost of the disposal of rubbish and garbage would be about the same as under the plan recommended but it would require a much greater capital outlay although entirely eliminating the cost of collection. It is not considered feasible to adopt this plan for the whole city, but it is recommended for outlying districts and it is suggested that the city might be justified in bearing part of the expense of constructing the household incinerators in such districts.

Concerning briquetting of garbage, it was stated that this is practicable although it was tried in Philadelphia 20 years ago and abandoned. However, it is believed that the commercial development of such a scheme should be positively demonstrated before a large city considers it.

Another proposition was to cook and dry the garbage and grind it as an ingredient for the manufacture of stock feed. The process should be sanitary and free from objectionable odors. It involves the separation from the garbage of metals, glass, etc. Although Toledo, Ohio, is building a plant for this form of utilization it is not yet in operation and the plant must still be considered as experimental.

World's Longest Tunnel for New York's Water Supply*

Conclusion of article in last week's issue. Special features of construction in unfavorable work. Contractor's plant.

SPECIAL FEATURES AT SHAFT 6

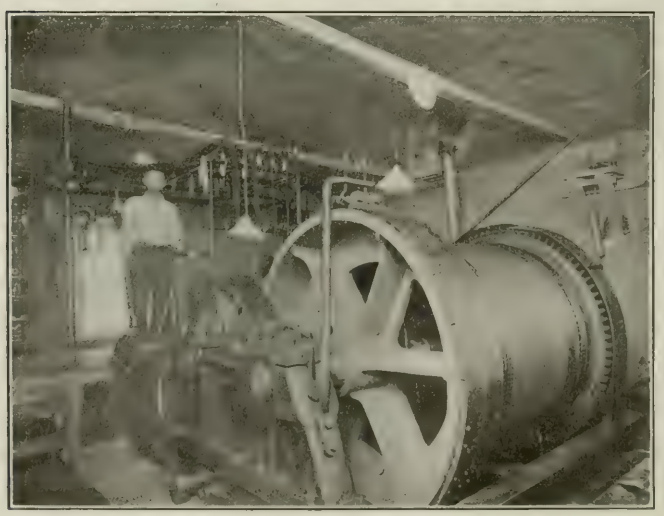
On each side of shaft No. 6 occur the highest mountains, their peaks extending about 2,000 feet and 2,215 feet, respectively, above the invert of the tunnel. Here the rock seems to be still under stress, although perfectly solid. This shows itself in a spalling off of the roof after the tunnel section has been excavated. There is no tendency for any large falls of rock in the roof, but there is a continuous breaking off of rather small pieces of sound rock. It does not therefore necessitate any very strong lining to uphold the roof, but a

(*Continued from Page 471)

sheathing is necessary to prevent injury to the men by the falling pieces. Moreover, it is thought that a comparatively light pressure exerted by roof timbering may prevent altogether the progressive spalling which in time would increase the height of the tunnel roof to an undesirable extent.

In this section, therefore, it is found necessary to timber the roof of the tunnel, and to keep this timbering completed very close behind the excavation. The timbering employed consists of bents placed a maximum distance of 7½ feet apart, each bent consisting of three timbers, the middle one horizontal and the others making an angle of about 45 degrees. These inclined side pieces were originally planned to be supported by resting their ends in "hitches," or shoulders excavated in the rock. It was found difficult, however, to complete a hitch furnishing solid support at the exact elevation desired and the contractor suggested and was permitted to use an alternative plan which has worked out very satisfactorily. Each end of a bent is supported by three 1¼-inch square steel pins 24 inches long driven horizontally 18 inches into the rock and placed about 3 inches apart horizontally. On these pins rests a 3-inch bearing plate, and on this plate the foot of the bent timber. Another alternative was to support the bent on posts placed in recesses in the sides of the tunnel; but the plan adopted avoids excavating for these posts and also keeps the entire timbering out of the way of the mucking cars and all working done in the tunnel.

This timbering is all placed above the outside line of the tunnel lining, there being a clearance of 17 inches between the bottom of the horizontal timber of the bent and the interior of the lining. On top of the bents are placed lagging boards of 3-inch by 6-inch material. These are spaced about an inch apart, thus allowing channels for the grout to follow in grouting the tunnel after the completion of the lining. The space



HOIST HOUSE AT SHAFT No. 1

SHOWING ELECTRIC HOIST. THE HOIST HAS A DRUM 4 FEET 6 INCHES IN DIAMETER AND IS BALANCED BY ONE CABLE ASCENDING WHILE THE OTHER IS DESCENDING. FULL CONTROL IS OBTAINED AT ALL TIMES BY MEANS OF A SOLENOID BRAKE AND A HAND BRAKE. IN CASE OF AN OVERLOAD OR ANYTHING HAPPENING TO THE CAGES, A SWITCH TO THE RIGHT OF THE OPERATOR'S HEAD CAN BE THROWN OUT, THUS SETTING THE SOLENOID BRAKE. THERE IS ALSO A CIRCUIT BREAKER, WHICH IN CASE OF AN OVERLOAD WILL AUTOMATICALLY THROW OUT. THE HOIST IS DRIVEN BY A "GENERAL ELECTRIC" 112-HORSEPOWER, 440-VOLT, 60-CYCLE, 154-AMPERE, 3-PHASE, INDUCTION MOTOR; SPEED, FULL LOAD, 150 REVOLUTIONS PER MINUTE. THIS DOES NOT SHOW IN THE PICTURE, BUT IS DIRECTLY BACK OF THE HOIST. TO THE LEFT IS A SERIES OF GRIDS THROUGH WHICH THE CURRENT HAS TO PASS BEFORE GOING TO THE MOTOR.

between the lagging and the tunnel roof is dry packed with rock fragments. After the completion of the concrete lining it may or may not be thought necessary to force grout into the dry packing.

In the tunnel north and south from shaft No. 6 wrought iron pipes are built into the roof timbering to be used in case it is decided to grout the dry packing in the roof, these pipes extending to within an inch or two of the face of the rock to be used as overflow pipe to determine when the roof space has been entirely filled with grout. Pipes for introducing the grout will be built in the concrete and will be set later when the concrete forms are placed, if it then seems probable that grout will be employed.

In driving the tunnel from shaft No. 6 the work was originally done by the top heading and bench method. On account of the necessity of keeping the roof timbering so close to the forward end, this was changed to a bottom heading with a bench above. This also, however, was soon discontinued, and the work now is being performed by excavating the full section, the entire face being shot at one time. In the two headings from this shaft the work does not progress quite so rapidly as at the others. Each heading alternates two blasts one day and one blast the next, thus averaging 1½ a day. The progress averages 60 feet a week as against 90 to 100 feet in the other shafts.

The material from the tunnel is wasted in spoil banks around the head of the shaft on land purchased by the city for this purpose. In addition to an easement of the land over the tunnel, the city has purchased the properties around the shafts as well as the area of the reservoir; the total amount of area taken being 2,452 acres in fee and 51 acres of easement.

CONTRACTOR'S PLANT

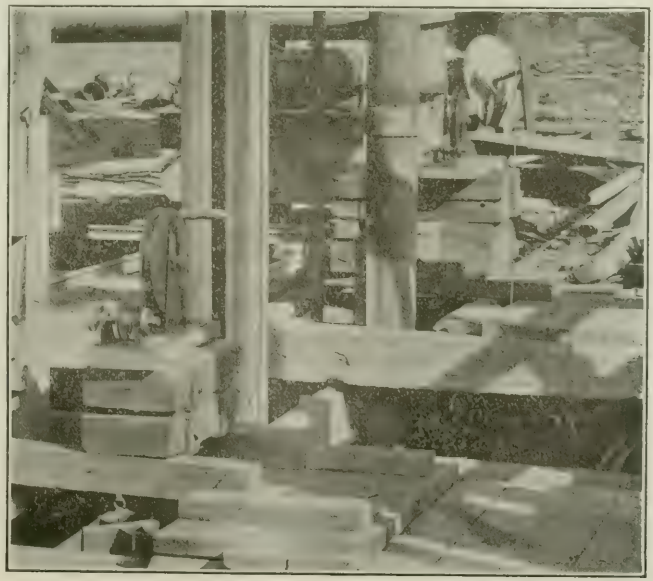
For power on the construction work the contractors on both the tunnel and the reservoir are using electricity furnished by the Central Hudson Gas & Electric Company, which has run its cables for this purpose a distance of about 50 miles in from its main trunk line which extends [illegible] are on wooden poles [illegible] line being looked upon as temporary only. The current is furnished [illegible] tween this company and th[illegible]

All of the power is derived from this current, but the drills are [illegible] ated by compressed air furnished by compressors operated by electricity, and the locomotives that haul the mucking trains are operated by storage battery.

The compressor plant at each [illegible] two Chicago Pneumatic Tool Compa[illegible] sors, each furnishing 741 cubic feet of free air per minute. The compressor is class O-CB low pressure cylinder 17 inches, high pressure cylinders 10 inches, stroke 12 inches, speed 235 r. p. m., 130 h. p., with 6-inch inlet and outlet pipes. This is run by a G. E. synchronous motor, 150 k. v. a., 130 h. p., 600 r. p. m., 60 cycle, 196 ampere, 400 volt, 3 phase.

Compressed air is carried to the tunnel headings through 4-inch pipes. Ventilating air is delivered into the tunnel through a 6-inch steel pipe by Connersville blowers. Water for the drills is pumped into the tunnel through a 2-inch pipe. Cables also carry current into the tunnel for operating the incandescent lights and for furnishing the 220-volt current used by the mucking machine and pumps.

In the hoist house at each shaft is a Flory electric hoist with a 4 foot 6 inch drum, balanced with one cable ascending while the other is descending. Full control is maintained by means of a solenoid brake and a hand brake. In case of an overload or for other reason, a switch at the



VIEW AT THE TOP OF SHAFT No. 5, SHOWING METHOD OF GIVING TUNNEL ALIGNMENT. ON EACH SIDE OF THE SHAFT IS A LINE DROPPING REEL CARRYING SEVERAL HUNDRED FEET OF No. 8 PIANO WIRE. THIS WIRE PASSES OVER A WHEEL (SHOWN IN FRONT OF EACH REEL) HAVING A DEEP "V" GROVE IN ITS CIRCUMFERENCE AND ADJUSTED IN HORIZONTAL POSITION, BY MICROMETER SCREWS, TO THE TUNNEL ALIGNMENT AS GIVEN BY A TRANSIT. THE WEIGHT SHOWN SUSPENDED AT THE ENDS OF THE WIRE ARE THEN LOWERED UNTIL THEY REST IN WATER IN BUCKETS AT THE FOOT OF THE SHAFT. FROM THESE WIRES, WHICH ARE ABOUT 11 FEET APART, THE LINE IS PROJECTED INTO THE TUNNEL. CONCRETE WEIGHTS HEAVIER THAN THOSE SHOWN ARE NOW BEING USED.

right of the operator's head can be thrown out, thus setting the solenoid brake. There is also a circuit breaker, which will automatically throw out in case of overload. This hoist is driven by a G. E. induction motor, 112 h. p., 440 volts, 60 cycle, 154 amperes, 3 phase, 150 r. p. m. At each plant there is a transformer station where the current is stepped down 2,200 volts to the 440, 220 or other voltage required by the several pieces of machinery and for lighting.

The drills used in the headings are all water Leyner drills manufactured by the Ingersoll-Rand Company, while the drilling in the bench is done by means of jackhammer drills manufactured by the same company. Sixty per cent dynamite is used, although a trial is being made just now of 40 per cent.

The muck is carried to the shafts in trains, each containing six cars hauled by a G. E. storage battery locomotive having two 5 h. p. motors, direct connected, 110 volts, the storage battery containing 48 cells. Eighteen cars are used for each heading, one train coming out full while another is being loaded and while the cars of a third are being lifted to the surface, emptied on spoil bank, and returned.

For performing the mucking, two or more types of mucking machines were tried and four of such machines manufactured by the Myers-Whaley Company have been purchased. The machines used are a No. 4 type mucking machine operated by a 20 h. p., 220 volt, 60 cycle, 49 ampere, continuous motor. This mucking machine consists of a small shovel which is pushed under the muck and throws it on to an endless belt, which carries it to the rear of the machine, where it falls into muck cars, which are run up one at a time under the overhanging belt. The endless belt is made in two sections, the forward one discharging on to the rear, and the rear one being pivoted near where the two belts meet, so that it can be swung several degrees either side of the axis of the machine. It is possible with this machine to load a 1½-yard car in about two minutes. Some quite large stone were being handled at the time of the writer's visit, one about 4 or 5 feet long, which is undoubtedly larger than it was intended that the mucker should handle. In shaft No. 6 about 50 cubic yards of rock is blasted at each shot and this is handled by the mucking machine and cars in about five hours, giving 10 cubic yards an hour. A large part of this time, of course, is consumed in shifting cars, each car as it is loaded having to be removed from under the end of the belt of the mucker and an empty run in to replace it.

Very little water enters the tunnel at any point. At shaft No. 1 about 65 gallons a minute is being pumped out through the shaft with about 4,000 feet of tunnel opened, and at shaft No. 6 only about 5 gallons of water per minute is being pumped, practically all of which enters in the shaft itself, so that in the tunnel the only water is that supplied from the surface for the drills. At shaft No. 1 the water is raised to the surface by a Gould triplex plunger pump electrically operated, while about 1,000 feet from the shaft is a booster pump of similar make. As the northern heading slopes downward from the shaft, water accumulates there and is pumped back through a drainage line, a small Cameron pump operated by air taking water from a sump near the heading.

State laws and regulations of the Board of Water Supply require strict adherence to sanitary regulations in the camps and the tunnels, chiefly with a view to protecting the water supply from contamination. (All camps are on either the Esopus or Schoharie watershed.) They also specify how the workmen shall be housed. For each group of houses there is a convenience station provided with chemical toilets, shower baths, etc. Each stream receiving drainage from a camp is treated with a heavy dose of liquid chlorine (about 10 pounds) at a point below probable contamination. In each tunnel heading is a toilet carried on a car which is taken to the surface daily to be emptied.

Each house holds eight or sixteen men in most cases. They are divided into rooms, each for two men with a cot apiece, a window in each room. In the center of the building is a stove for heating. The room partitions are carried about eight feet high only, giving abundant ventilation between the tops of the partitions and the roof. The floors are well above the ground, which prevents dampness. Windows and doors are screened.

ENGINEERING

For aligning the tunnel the line is carried down the shaft by means of two No. 8 piano wires suspended from the surface and carrying at the bottom concrete weights weighing 40 pounds each, made in the section of a cross and suspended in a pail of water. (It requires about 10 minutes for the vibration of the wires to cease after they have been adjusted in alignment.) The wires are adjusted by running each of them over a vertical wheel with a deep, sharp V notch in the circumference, which wheel is adjusted horizontally by means of a micrometer screw. The wires are little over 11 feet apart and hang free just inside the lining of the shaft. They are set by transit on the surface, permanent stone monuments being located on each side of the shaft head to be used for this purpose. The line is carried forward in the tunnel by means of brass scales set in the roof, an instrument platform being suspended from the roof under each scale and the center line being marked on each scale. Twenty-four observations are taken by a shifting-head transit for fixing each alignment point.

The work is under the immediate charge of George G. Honness as department engineer, J. Waldo Smith being chief engineer of the Board of Water Supply and Thaddeus Merriman deputy chief engineer. The work is divided into three sections, each in charge of a division engineer. The Allaben or southern division is in charge of Charles M. Clarke, William B. Hunter is in charge of the Prattsville or northern division of the tunnel, and James A Guttridge is division engineer of the Gilboa division, which includes the Gilboa dam and reservoir. Thomas S. Shepperd is general superintendent of the Shandaken Tunnel Corporation.

Important Features of Highway Design

More attention needed to principles, standards and economics. Continued and assured Federal aid essential.

That the great importance of increasing the mileage of hard-surface roads in this country is being recognized is indicated by the estimate that there is now available from all sources the sum of $1,130,000,000 ready to be used in 1921 for highway work in the United States.

Labor, materials and transportation enough to require all this expenditure will not be forthcoming, nor will plans be perfected and preliminaries completed for so much work this year, but the prospect is inspiring for the future and plans should be made to maintain increasing road activities in the future, remembering that legislation and systemization are necessary and that such efforts progress slowly.

Special attention should be given to co-ordination and co-operation between local, state and Federal authorities and the development of economical, comprehensive and efficient systems of through routes, trunk lines and feeders.

The proper design and construction of future roads requires systematic and comprehensive study of the relation of soils to road design, particularly a consideration of surface failures in certain kinds of soil. Attention should also be given to the control of road materials by laboratories and tests.

Improved standards must be developed, but cannot properly be fixed until after the development of highway economics, the rational application of which will establish some facts at variance with the ordinarily accepted doctrines. It will, for instance, sometimes be found permissible that a road should be designed and constructed with a life considerably less than that of the bonds required to finance its building, as when the opening of the road will immediately insure important traffic that will rapidly develop the adjacent country, create wealth and increase business.

Sometimes, too, the construction of a road with strength or durability known to be less than the maximum requirements will be justified by the greater rapidity of construction or the amount of service it can probably perform before it fails and by the ultimate total cost of construction, maintenance and reconstruction for a certain period of years. This is illustrated by 4-inch concrete roads in California, that, as compared with much thicker roads than would have lasted longer have had a higher ratio of value to cost than have the more expensive roads.

In many states Federal standards should be adopted for improvements, such as width of roadway, alignment, grade crossings and building of permanent drainage [illegible] should also be given to some important [illegible], such as the construction of shoulders and appurtenances like parapets, guard rails, signals, lighting, and to the best realization of local resources for materials and [illegible].

It must be remembered that [illegible] rapidly increasing traffic from millions of automobiles already in service in this country [illegible] arisen the necessity of constructing and maintaining important highways over comparatively long stretches of undeveloped or uninhabited country where the local residents cannot be expected to finance the project and the government must bear a large portion of the cost, which will eventually be more than justified by the benefit to the entire area and adjacent sections.

PROPORTIONS OF DIFFERENT CLASSES OF [illegible]

A large amount of roads must be built, and while the costliest and most durable hard surfaces are automatically being adopted for the business centers, it is necessary to build a very large mileage of lower cost roads selected with proper consideration for local conditions and requirements. At present Federal roads are put under four classes, the total mileage and cost of which up to January 1, 1921, are shown in the following table:

Type	Mileage	Per cent mileage	Total cost	Per cent of total cost
Class 1.				
Earth	3,7[illegible]1	21.5	$3,1[illegible],[illegible]09	7.7
Sand-clay	1,[illegible]21	1.[illegible]	[illegible],[illegible],574	3.5
Shell	[illegible]7	.2	[illegible],[illegible]51	.1
Gravel	5,[illegible]5[illegible]	32.5	47,[illegible]1[illegible],[illegible]76	16.[illegible]
Gravel (surface treated)	855	5.1	4,[illegible],[illegible]33	1.[illegible]
Total	11,087	60.3	$[illegible],[illegible],[illegible]68	29.6
Class 2.				
Water-bound macadam	542	3.1	5,[illegible]58,[illegible]77[illegible]	1.[illegible]
Water-bound macadam (surface treated)	97	.6	1,433,499	.5
Bituminous macadam	714	4.1	16,669,782	5.9
Total	1,153	6.7	23,362,060	8.3
Class 3.				
Rock asphalt	51	.3	1,[illegible]78,[illegible]93	.7
Bituminous concrete	496	2.9	15,[illegible]64,756	5.3
Concrete	3,[illegible]8[illegible]	19.2	12,[illegible],[illegible]62,[illegible]68	42.[illegible]
Brick	351	2.0	15,725,494	5.6
Sheet asphalt	48	.3	1,572,472	.6
Total	4,254	24.7	154,970,323	55.1
Class 4.				
Undetermined	392	2.3	19,796,[illegible]67	7

Economy in Designing Roads

In view of the thousands of miles of roads that are being built each year, each mile costing several thousand dollars in most cases, economies which seem minor become of important magnitude when spread over the entire annual expenditure in this country. In his recently issued book on the "Location, Grading and Drainage of Highways," Wilson G. Harger states that during the years 1913 to 1920 he carefully reviewed plans for some two thousand miles of road from different sections of the country with the idea of forming a conclusion as to the trend of highway design and to learn how closely current practice followed well-recognized principles of highway engineering. He came to the following conclusion:

"About 25 per cent could be classed as first-class designs from an economical standpoint. Practically all the designs showed minor wastes, but for the plans classed as good, revisions would

not result in any practical advantage. About 75 per cent of the plans showed a material expenditure of money for which no adequate return was obtained, amounting to from 5 to 20 per cent of the cost. On some of the roads which, as built, served the traffic well, this excess might better have been spent on other jobs. On some of the roads which, as built, were not up to the requirements of the traffic, the waste might better have been applied to their own improvement in fundamental features.

"The general faults most noticeable were:

Too much spent on the reduction of intermediate grades.

Too much spent to obtain long straight grades.

Too much spent on sections with deep ditches.

Not enough spent on re-alignment at dangerous locations.

Not enough spent on re-location necessary to get reasonable maximum grades.

Not enough spent on long-span bridges.

Too much spent on width of macadam.

Not enough spent on depth of macadam.

Too much spent on imported materials where local materials were available in limited quantities.

"Systematic grading design will often reduce the work from 500 to 2,500 yards per mile, amounting in money, on an average, to from $500 to $1,000 per mile. The proper use of local material, particularly in foundations, is a large factor in economy and will often reduce the cost from $1,000 to $3,000 per mile. Reasonable variations in pavement width and in the thickness of surfacing courses is effective and in many cases saves from $1,000 to $2,000 per mile. A very conservative estimate of savings due to these systematic minor alterations is from $1,000 to $2,000 per mile. These savings are not spectacular for any one job, but if constantly used their advantage on any large program is very evident. They will more than pay for all the necessary engineering work in connection with the entire program. The small additional work required for a careful analysis is the best possible engineering investment for the community that can be made."

Special Engineering Construction Lectures

The necessity of giving instruction to engineering students in so many vital academic subjects makes the curriculum of the technical college a severe one, and leaves little time for any requirements that can be dispensed with. It has been, however, for several years, customary for practising engineers to give advanced students lectures describing the design and construction of important engineering work, generally in their own practice. Such lectures are usually intended to show the students the results to be attained by technical preparation; to arouse their interest in and appreciation of construction operations, and demonstrate their close relation to mathematical and scientific design, without involving much time or study and thus afford a welcomed variety in their routine.

On May 18, Clarence D. Pollock, consulting engineer, New York City, gave a lecture on the Construction of Stone Block Pavements before the civil engineering students in the Junior class, numbering 135 students, at the Massachusetts Institute of Technology.

This lecture was given in connection with Prof. C. B. Breed's course in Railway and Highway Engineering.

The various kinds of stone block pavements were described and the best methods of laying them were explained and the steps in construction were illustrated by lantern slides.

On May 23-24 Frank W. Skinner, associate editor of Public Works, lectured to the Junior and Senior classes in the College of Engineering, Cornell University, on the Construction of Shield Driven Tunnels, the Construction of Concrete Bridges, the Construction of Cribs and Cofferdams and the Construction of the Water Works of New York City, San Francisco and Winnipeg.

These lectures were selected from a long list formerly delivered by Mr. Skinner regularly at the Cornell College of Civil Engineers (this year consolidated with the other Engineering Colleges at Cornell) and occasionally or in part at a dozen other engineering colleges. The lectures outlined the state of the art, ordinary difficulties, requirements, operations, methods and plants, and were profusely illustrated with lantern slides of standard and notable work and equipment.

Water Maintenance in Springfield

During the year 1920 there were 38 leaks in the 237 miles of supply and distribution mains of the water works of Springfield, Mass. an average of approximately one to each six miles of main. Eighteen of these leaks were at defective joints, 3 were broken sleeves, 5 were from cracked pipe, 5 were at hydrant connections, one was the blowing out of an 8-inch plug, one a piece of a burst pipe, and 5 of lesser importance. The total cost of repairing these leaks and of damages paid for flooding the property because of them amounted to $12,603.

The hydrants in that city suffered more than in the previous year from automobiles, 29 having been broken by skidding or carelessly driven cars. Bills for repairing 13 of these have been collected from those responsible for the breakage, 2 had not yet been paid, one had not yet been billed, and 13 were charged to maintenance as it was impossible to learn by whom they were broken.

It is the regular practice as part of the inspection of the system in Springfield to regularly inspect all hydrants and keep them in working condition. Also to inspect the gates and operate them.

Apparently the Springfield department suffers as do so many others that have inherited a system built years ago in that there are no exact records of the location of many of the old mains and valves, as Mr. Martin reports that "the work of inspecting and relocating stop boxes and service pipes is progressing intermittently by the gate inspection gang and sketches made as far as locations can be determined."

PUBLIC WORKS

Published Weekly
by
Municipal Journal and Engineer, Inc
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba....$3.00 per year
All other countries .....$4.00 per year

Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses

Telephone (New York): Bryant 9591
Western office, Monadnock Block, Chicago

A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

CONTENTS

BALTIMORE WASTE DISPOSAL REPORT 495
WORLD'S LONGEST TUNNEL FOR NEW YORK'S WATER SUPPLY—Illustrated 496
IMPORTANT FEATURES OF HIGHWAY DESIGN 499
Economy in Designing Roads 499
Special Engineering Construction Lectures 500
Water Maintenance in Springfield 500
EDITORIAL NOTES 501
Construction Certainties—Up to Date Tunneling
Engineers Wanted for California Bureau of Architecture 502
5,000 MILES OF AMERICAN HIGHWAY BUILDING ANNUALLY 502
Refuse Disposal in London Boroughs 503
STREET CLEANING IN CINCINNATI 504
PAVING MATERIALS I VARIOUS COUNTIES.. 505
LINING A 20-FOOT WELL, 50 FEET DEEP..... 507
Delivering Bulk Cement and Water to a Concrete Mixer 509
Sugar Beet Sap Destroys Concrete Roads 509
RECENT LEGAL DECISIONS 510

Construction Certainties

It is certain that there are many hundred million dollars of capital in this country eagerly awaiting safe and profitable investment; it is certain that nearly all kinds of construction are far behind a normal schedule and that billions of dollars' worth of new works, composed chiefly of labor and materials, are required for national comfort and safety, to say nothing of progress; it is certain that considerable numbers of workers of many classes are unemployed, and that very many who are employed are inefficient and unreliable and that many are deliberately fighting for restricted output and disproportionate wages; it is certain that there are and can soon be supplied abundant materials and equipment for executing construction work of all sort; and it is certain that the facilities for transportation and distribution of materials and equipment are not at present operated to full capacity and if coordinated and effective, could handle a vast amount of continuous construction business.

It is thus seen that the financial, commercial and physical factors are all adequate for the immediate resumption of construction in a large and wide field. It is [illegible] the most powerful [illegible] in this country [illegible] it. Obstructing conditions [illegible] remedied, construction [illegible] we are fully justified in the [illegible] struction will steadily increase [illegible] mentum faster and faster, improving [illegible] ditions and bringing resumption [illegible] in the very near future.

A very experienced and influential [illegible] has just stated that numerous personal reports from contractors, engineers and officials in widely distributed points throughout the country announce the improvement of construction conditions "from minute to minute," and state their belief that marked and reliable increases will be very large by next fall.

Unlawful combinations and profiteering dealers are being exposed and severely punished. The prices of materials are still generally decreasing. Labor demands are slowly being revised, excessive wages are being reduced and efficiency increased. These corrections must be universally continued with the utmost vigor and persistence. The immediate commencement of billions of dollars of deferred, urgent railroad and municipal improvements, housing and enormous highway construction, as indicated by the discussion on page 504, as well as various vital industrial needs, demand immediate attention, and it is good judgment on the part of those interested to anticipate the inevitable results and to prepare thoroughly in advance for the fast approaching harvest that will yield profits in accordance with the confidence and preparation with which it is met.

Up To Date Tunneling

The construction of the unprecedentedly long Shandaken tunnel for the Catskill water supply to New York City, that is described on page 496, is of unusual engineering importance and is being handled with corresponding skill and experience that has developed notable and interesting features in the design and method of construction.

Although the mountain division of the Hetch-Hetchy aqueduct tunnel for the water supply of San Francisco has also a length of 18 miles, it is interrupted at a point 4½ miles from one portal by a deep narrow valley, which provides two additional portals for the tunnel construction, while the Shandaken tunnel is continuous from portal to portal without any emergence from the mountains under which it passes. This feature involves important considerations of transportation of material and of ventilation as well as the provision of enough working faces to permit the tunnel to be built within the required time. This was attained by the seven intermediate shafts at approximately equidistant locations, at low points in the valleys above the tunnel alignment, although practical developments have indicated that the contractor may find it more advantageous to omit drifting from the foot of one of the shafts and complete the tunnel excavations from the other headings.

A wise appreciation of the value of preliminary investigation led to subterranean exploration by more than 150 diamond drill borings along the proposed alignment to disclose the character and position of the deep rock strata. Considerable time and expense were involved, but were well applied, enabling the engineers to plan in advance for grade and location that promised the most satisfactory tunneling conditions. It caused the rather unusual feature of depressing the intake end of the tunnel 174 feet below the surface, and 135 feet below the hydraulic grade so that the upper end of the tunnel starts at the foot of a shaft, instead of from a portal. Practical reasons have also induced the contractors to drive a heading wholly from the last shaft, rather than from the lower portal, so that the unusual condition is presented of a very long tunnel with no working portals. The horizontal location deviates from a straight line in order to secure most favorable locations for the shafts which at best have an aggregate length of 3,238 feet.

Although the nearly horizontal stratification of the rock and its general quality are favorable and no slide slips are threatened, there is liability of falling from the roof, which is safeguarded or diminished by timbering that is necessarily kept inside of the limits of the concrete lining. In order to avoid a considerable rock excavation for the lower ends of full height bents, the ingenious expedient has been devised of supporting the three-segment roof bents on steel dowels drilled into the rock walls.

The arrangement of the permanent heavy roof lagging is also calculated with a view of providing for the most efficient circulation of grout between the boards if grouting is necessary after the concrete lining is placed. It was originally intended to drive all the tunnel with top headings, but in one heading where this was found unsuitable the contractor did not hesitate to change it to a bottom heading and after some trial again changed to a full face drift with the full dimensions of the finished tunnel, which is found to work more satisfactorily.

The contractors have not hesitatde to install equipment of a quality and amount proportionate to the importance of the work and have invested about $1,000,000 in the plant, for all of which power is derived from electric current brought in on a special line operating motors that drive air compressors and other apparatus, thus saving the cost of hauling coal and maintaining steam plants. The main shafts are fitted with counterbalanced elevators, the most efficient types of drills are selected for the headings and bench work and the muck is handled by several powerful machines that save time and labor by delivering it without hand work to the dump cars hauled by electric storage locomotives, hoisted to the surface and returned to the tunnel in regular succession with equal credit to the engineers and contractors.

Engineers Wanted for California Bureau of Architecture

The California State Civil Service Commission requests us to announce that examinations will be held for the positions of associate mechanical engineer with the engineering division of the Bureau of Architecture of the State Department of Engineering, and for the position of chief engineer with the same bureau. For the former position the entrance salary is $285 a month, which may be increased to $315. For the position of chief engineer the entrance salary is $360 a month with prospect of an increase to $380. Examinations will be held in Sacramento, San Francisco and Los Angeles as soon as possible after June 25, which date is the last day for filing applications.

Both of these positions have as their duties the design, construction and repair of the institutional buildings and structures of the state. Candidates must have had not less than four years in one case and eight years in the other of engineering experience, preferably mechanical.

Persons desiring to enter the examination may secure application blanks from the State Civil Service Commission at room 331, Forum building, Sacramento, or any office of the State Free Employment Bureau.

5,000 Miles of American Highway Building Annually

Reasonable prospect for spending $200,000,000 a year for construction and $20,000, for equipment every year in preparation for a new era of National development.

In a recent address to the executive board and guests of the Associated General Contractors of America, Past-President W. A. Rogers said in part:

There are in this country to-day approximately 2,500,000 miles of highways, of which about 50,000 miles might be developed into national or interstate routes or "Main National Routes." There are about 400,000 miles of highways which are state trunk lines and which lead into important centers and to and from important market points. I assume that eventually this 450,000 miles of highway will be improved in some form. There are now approximately 300,000 miles improved to a greater or less degree; approximately 45,000 miles are hard-surfaced, 15,000 of which are concrete, and the balance of the 300,000 miles are of gravel or similar form of surfacing . . .

I feel sure that in the near future we will be building 5,000 or more miles of concrete roads per annum. In order to get what this means intelli-

gently before us, I am presenting the following figures. For this purpose I have assumed the cost of $40,000 per mile. This would mean for 5,000 miles of highway approximately $200,000,000 expenditure per annum, the employment of about 100,000 men directly on the construction of this 5,000 miles for a period of about eight months, and the indirect employment in the manufacture and preparation of the materials entering into the construction of the highway of approximately an equal number of men, or a total of 200,000 men for a period of about eight months or an expenditure of $150,000,000 directly for labor per annum.

In addition, an investment in plant of sixty to eighty millions per annum is required to construct a program of this size, which investment would have to be renewed at least every four years.

It seems to be a fact that in the history of this country some form of construction has been the factor that has made possible the subsequent development of the country, for example, the construction of canals permitted the development of Ohio, construction of the railroads in the twenty years after the Civil War permitted the development, agriculturally, of the western country.

Often this development has seemed to be in advance of its need, but subsequent history has proved that the money has been well spent and that the rapid development of the country has only been made possible by this construction. It seems to me that we are facing an era of highway development comparable to the railroad development in the '70s and '80s. With the history of the past before us, and in view of the magnitude of work to be done, it is well to consider how the interests of the public may be best conserved in this work. . . .

If the better class of our contractors are to be induced to do this class of work, there are certain cardinal principles which must be adopted in connection with this work. Three of these principles I designate as Standardization, Stabilization, and Co-operation. Let me eplain.

We have in this country forty-eight states and each state has its different type of highway, different specifications as to materials and workmanship, different methods of payment and different types of organization for handling the owner's side of the work.

The contractor who gains his experience and adapts his plant for work in one state, has to remodel and recast his ideas for work in another states. Cost data gained in one state or even sometimes in one county of the state are not applicable without adjustment for another county or in another state.

Materials acceptable in one state may not be in another. The proportions of concrete materials are different. Take the one item of time of mixing the concrete. One state may require that the concrete be mixed a minute, another state a minute and a half to get the same results, when probably mixing half or three-quarters of a minute with a satisfactory machine would give equally good concrete. . . . By stabilization I mean that a definite program covering a period of years should be adopted. The investment in plant and organization for highway work is greater than that of almost any contract work, in proportion to the volume of work. It is hardly reasonable to expect a large outlay for plant to handle this work will be made unless there is reasonable assurance that it will be employed long enough in reasonably profitable work to justify the investment.

Definite programs of work should be adopted by the state or federal government covering a fairly definite amount of work to be done each year in the various districts for a period of years

---

Refuse Disposal in London Boroughs

The problem of disposing of the refuse from the various boroughs in the metropolitan area of London is increasing greatly in difficulty and a committee has been appointed by a conference of the borough councils to consider the best methods to be adopted. This committee recently submitted a progress report setting forth existing conditions and tentative suggestions.

From this report it appears that the amount of refuse to be dealt with amounts to 1,500,000 tons a year. At the present time most of this is removed by barges or by rail to dumps in the outlying districts, where it constitutes a nuisance because of odors and of the rats and flies. Naturally the difficulty of finding new dumping sites increases yearly. The refuse not dumped is burned in destructors or is screened and salvaged. Prior to the war the cost of removing in barges averaged 62 cents a ton, but the cost now is about $2.25 a ton, the annual cost in one borough being nearly $250,000 last year (converted from English money on the basis of $5 to the pound). In most cases railway rates are higher than barge rates.

The suggestion had been made that a number of boroughs might combine for removing their refuse and acquire land for dumps by condemnation, but the committee believes that centralization would involve additional transport and dump difficulties without corresponding advantages.

The committee gives a preliminary opinion that it will probably be found most practicable to utilize the refuse, as is done in several cities, in some of which they found that salvaging actually produced an asset in relief of taxes. However, most of these salvaging schemes are still in the experimental stage and definite conclusions are not yet available.

Commenting on this editorially, the English Journal, "Municipal Engineering and the Sanitary Record," points out that: "If most local authorities screened and sorted the refuse it is highly probable that a glut of such salvage material as tins, rags and paper, which together constitute 5 per cent of the whole, would be created. At the present moment the demand for each of these classes of material is remarkably low, although efficient sales managers, such as those at Westminster, Marylebone and Sheffield, somehow find a market for them. It may mean that local authorities will find it necessary to establish factories or encourage establishments of factories

for their conversion into readily marketable products, as is the case in Belgium and Germany, as the quantities produced in London alone would be enormous. On the other hand, there will be a big reserve from cinders, which constitute 45 per cent of the screened refuse, whilst the fine dust, which constitutes 31 per cent of the total, should be readily disposed of to farmers." It is reported that Sheffield obtained a revenue of more than $15,000 for the year ending March 25, 1920, from its waste utilization, even before the screening plant had been installed.

Street Cleaning in Cincinnati

The decrease in working force led Superintendent Maag to adopt the use of machinery for sweeping and flushing, and for cleaning catch basins.

The annual report for 1920 of the Department of Streets, Sewer and Catch Basin Cleaning of the city of Cincinnati, by Fred Maag, the superintendent of the department, contains as usual a very complete statement of the amount of work done and the unit costs of the same for each of the several months and for each of the operations carried out. Cleaning and flushing are measured in terms of a "square" of 16,000 square feet as a unit.

Practically all costs were greater in 1920 than in 1919. For instance, the average flushing cost per unit increased from 13.1 cents in 1919 to 15.1 cents in 1920, the broom gang from 24.1 cents to 32.0 cents, etc. Overhead costs increased about 25 per cent, varying in the different operations from 19 per cent to 38 per cent. Most of the operations were less in volume for 1920 than for 1919, but in spite of this the total cost of all operations was about 20 per cent greater.

Probably the most interesting feature of this year's report is that dealing with the introduction in the department of labor-saving machinery. This was done largely in the interest of economy, and also because of the difficulty of obtaining labor. "For some time past the street cleaning department has been operating with a greatly reduced force, and this in face of the fact that the fewer men have now more streets to clean than ever before. The normal roster of employees contained 582 names; at the present time and even for a very considerable previous period we have been functioning with 320 men, including the sewer cleaning gangs and supervision of operations."

With work constantly increasing and working force diminishing, machinery seemed to be the only solution and correspondence was entered into with the leading manufacturers of street cleaning machinery. "Extended investigations, try-outs and practical demonstrations were witnessed and plans to motorize certain functional operations were set on foot." Tests of machines were made in the city itself and "the conclusion was reached that street cleaning by machinery must be one of the permanent adjuncts of the department, as the success of demonstrations was clearly proved to all who viewed the working of same."

Two pick-up street sweeper machines of Elgin manufacture were purchased, being the first of the kind ever seen in Cincinnati. It is stated that the machine can clean about 50 miles of street in eight hours, or 100 miles if the machine worked two shifts a day. "The sweeper has a small brush on the side that cleans out the gutters. This is followed by the larger or main brush about eight feet long, and the dirt and sweepings are thrown in a belt conveyor to a box carried on the front of the machine. This box when filled is then motored to a given point where the dirt is let out and carried away to the point of permanent disposal. The preliminary operation of these machines was such a pronounced success that we look into the future with great confidence and expectations of results to be achieved.

"The purchase of a suitable type of auto street flusher presented many perplexities to arrive at a decision on the class of machine that would be best adapted for the streets of our city. After much experimenting and observation, coupled with past experience, four of the most modern and improved auto flushers were purchased. Each carried 1,500 gallons of water, compared to 500 gallons carried by the old horse-drawn flusher. In the new apparatus the water is forced by the use of centrifugal pumps provided with special auxiliary motors. An even flow and constant pressure is thus provided by this means. In a single trip this machine can thoroughly flush a street forty feet wide, an accomplishment which was impossible with the old-style flusher." The machine purchased is a Studebaker flushing apparatus on a Pierce-Arrow chassis.

Both sweepers and flusher have been in use too short a time to enable Mr. Maag to give us any exact figures of the work performed or unit costs, but later we hope to be able to give such figures.

"The cleaning of sewers always presented a strenuous proposition, involving the actual entry of the workman into the basin in order to clean same by the old laborious hand method of filling the buckets, and withdrawing the same to the surface by windlass, operated also by hand by the men on the surface and then depositing same in the waiting wagon. This was the system pursued for years and years, and in line with progress our investigations proceeded to find if it were not possible to devise other and better means to facilitate basin cleaning, and without the necessity of the workmen going into the hole, as the basins were so called.

"In fact, it was becoming more and more difficult to hire men for this class of work, on account of this one objectionable feature, of having to go into the sewer to make the clean-out."

For this service a machine for pumping out catch basins was purchased from the Springfield Engineering Co., "and the results achieved have been all that was claimed and more. It is safe to assume that it will pay for itself in short order through the saving made over the old method of hand cleaning."

Paving Materials in Various Counties

Reports from hundreds of counties throughout the United States telling where contractors can obtain stone, gravel and sand that will be satisfactory to county engineers for use in concrete, macadam and gravel road construction.

(*Continued from Page 459*)

Palo Alto—A no, B no, C 60 or 70 miles, D yes, E yes, G yes.
Pocahontas—A one, B one, D yes, in parts of the county, E yes, H 25 miles.
Sac—A no, B no, C 150 miles, D yes, E yes, G yes.
Scott—A 5, B 5, D no, F 20 miles, G yes.
Tama—A none opened, C 14 miles, D no, E no, G yes.
Union—A no, B no, D yes, E yes.
Van Buren—A no, B no, C 50 miles, D not developed, E yes, F 50 miles to sand bank, G yes, if opened, H 50 miles.
Wapello—A none, B none, C 75 miles, D yes, E no, F 100 miles, G yes.
Warren—A no stone at all, B none, C 50 miles by R. R., D none at all, E one bar in river, F gravel 23 miles, G yes, if washed, H usually buy gravel, no economy to ship stone.
Webster—A no, B no, C 125 miles, D yes, E yes, G yes.
Winneshiek—A yes, B yes, C McGregor, Ia., D yes, E yes, F Claremont or Mason City, G yes, H Claremont or Mason City.
Worth—A no quarries, D lots of gravel, G yes.
Private Work—A no, D no, E no, F average 40 miles, G no, H average 40 miles.

KANSAS

Allen—A yes, B yes, D do not think so, E yes, G no, H 100 approximately.
Anderson—A yes, B yes, D yes, E yes, G none, H 90 miles to Kaw river sand.
Atchison—A yes, B no, D yes, but not economically, E yes, G river sand.
Barber—A no, B no, C 190 miles, D yes, several by screening, E yes, by screening, G rivers and streams full of it.
Barton—A no, B yes, C 25 miles, D yes, E yes, G yes.
Brown—A no, B no, C 30 or 40 miles, D none, E no, F 30 or 40 miles, G no, H 50 to 100 miles.
Butler—A yes, B yes, D yes, E yes, G no, H Wichita, Kan.
Cherokee—A yes, B yes, D waste from lead and zinc mines, E yes, G yes.
Clark—A no, B yes, D no, E yes, G yes.
Crawford—A yes, B yes, D no, E no, F next county west, G no, H all sand shipped from Kaw and Arkansas river points.
Elk—A plenty of limestone, B plenty, D very few, E few, river gravel used mostly for roads, G no, H Wichita 80 miles, Topeka 150 miles.
Finney—A no, B no, C 200 miles, D yes, E yes, G yes.
Geary—A yes, B yes, D no, E yes, G best quality from river bars.
Graham—A yes, B yes, D none, except crushed stone, E as above, G yes, banks and river.
Greeley—A no, B no, D 1, E 3, G yes, in abundance.
Harper—A none, B none, C 70 miles, D no, E yes, G yes.
Johnson—A yes, B yes, D yes, E yes, G yes.
Kingman—A none, B none, C 70 miles, D none, E none, F 100 miles, G yes.
Labette—A yes, B yes, D yes, E yes, G no, H sand must be shipped in.
Lyon—A yes, B yes, D yes, by washing, E yes, G limited amount, H 64 miles shipped.
Marion—A yes, B yes, D no, E no, F 60 miles, G no, H 20 miles.
McPherson—A no, some stone of fair quality, B none, D yes, E yes, G yes.
Meade—A no, B no, C 300 miles, D some, E some, G yes.
Mitchell—A yes, but not extra good, B no, C 35 miles from Beloit, D no, E no, F 15 miles from Beloit, G yes.
Montgomery—B yes, E yes, H 75 miles.
Nemaha—A no, C 75 miles, D no, F 30 miles, G no, H 30 miles.
Norton—A no, B no, D yes, E no, G yes.
Osage—A no, B possibly, D not desirable, E yes, millions of cubic yards well distributed, G no, H Kaw river Topeka 15 to 50 miles.
Pawnee—A no, B no, C 80 miles, D yes, E yes, G yes.
Russell—A yes, for bridges, D yes, E none, G yes.
Sedgwick—A no, B no, C 200 miles, D no, E no, F 65 miles, G yes.
Shawnee—A yes, B yes, D no, E yes, G no.
Smith—A yes, B yes, D no, E no, G yes.
Stafford—A no, B no, C about 150 miles, D yes, E yes, G yes.
Wabaunsee—A yes, B not very suitable, D no, E yes, G yes.

KENTUCKY

Allen—A none, B yes, D creek gravel, G creeg sand.
Barren—A all you want, B yes, D yes, G yes.
Bracken—A yes, B yes, D no, E no, G no, H shipped in 50 miles.
Carroll—A yes, B yes, D yes, E yes, G yes.
Daviess—A no, B no, C 55 miles, D no, E yes, G yes.
Fleming—A yes, B yes, D no, E yes, G no.
Gallatin—A yes, but not used, B surface, D plentv, E plenty, F all along Ohio river, G yes, H 10 miles.
Hopkins—A one just opened, B 40 miles, D no, F 40 miles, Go no, H 40 miles.
Mason—A no, B yes, D yes, G yes.
Montgomery—A not many, D no, E yes, G no.
Morgan—A yes, B no, C 50 miles, D yes, E yes, G yes.
Oldham—A yes, B yes, D no, E yes, G yes.
Owen—A 2, field limestone scattered over entire county, D no, E no, G no.
Pike—A yes, B bituminous, C limestone 110, D no, E no, F 110.
Rockcastle—A yes, B yes, D yes, E yes, G yes.
Shelby—A no, B yes, D no, E yes, G no, H has to be shipped 30 miles.
Whitley—A none, B none, C 36 miles, D none, E none, G none.

LOUISIANA

Avoyelles—A no, B no, C 50, D no, E no, F 50, G yes.
Caldwell—A no, B no, C 30 miles, D no, E no, F 30 miles, G no, H 30 miles.

MAINE

Knox—A yes, B yes, D yes, E yes, G yes.

MARYLAND

Kent—A none, B none, C 50 miles, D none, E 50, G 50.

MASSACHUSETTS

Athol—A yes, B yes, D yes, E yes, G yes.
Essex—A yes, B yes, D yes, E yes, G yes.
Middlesex—A yes, B yes, D yes, E yes, G yes.

MICHIGAN

Alger—A yes, B yes, D no, E yes, G yes.
Cass—A no, B no, C 125 miles, D yes, E yes, F 2 miles, G yes, H 3 miles.
Dickinson—B yes, D yes, E yes, G yes.
Eaton—A no, B no, C 150 miles, D yes, E yes, G yes.
Emmet—B yes, D yes, E yes, G yes.
Grand Traverse—D yes, E yes, G yes.
Kalkaska—A no, D yes, E yes, G yes.
Lapeer—A no, B no, D yes, E yes, G yes.
Luce—A yes, B yes, D yes, E yes, G yes.
Macomb—A no, B no, C 40 miles, D yes, E yes, G yes.
Mason—A no, B no, C 100, D no, E yes, F 60 miles, G yes.
Missaukee—A no, B no, C 50 miles, D yes, E yes, G yes.
St. Joseph—A none, B none, C 80 miles, D yes, E yes, F several in county, G yes, H several in county.
Washtenaw—D yes, E yes, G yes.

MINNESOTA

Aitkin—D yes, E yes.
Big Stone—A yes, B yes, D yes, E ves, G yes.
Blue Earth—A yes, B yes, D yes, E yes, G yes.
Brown—A no, B no, C 3 miles, D yes, E yes, G yes.
Carlton—D yes, E yes, G yes.
Carver—A yes, B yes, D yes, E yes, G yes.
Chippewa—A none, B none, C 100 miles, D very few, E yes, F on roadside, G yes, H 6 miles from nearest R. R. point.
Chisago—A yes, B yes, D yes, E yes, G yes.
Cottonwood—A none developed, but plenty of rock, C 60 miles, D yes, E yes, but they vary, G yes, but limited.
Dodge—A yes, B yes, D yes, with screening, E yes, G yes.
Faribault—A no, B no, C 40 miles, D no, E yes, F 40 miles, G no, H 40 miles.
Goodhue—B yes, D for building, but not concrete road surface, E yes, G yes.
Grant—A no, B no, C 70 miles, D yes, E yes, G yes.
Hubbard—A none, B none, C unknown, D yes, E yes, G yes.
Isanti—A no, B no, C 50 miles, D no, E yes, F 50 miles, G no, H 50 miles.
Jackson—A none, B none, C 100 miles, D large number, E lots of gravel, G quite a few.
Kandiyohi—A no, B no, C St. Cloud, 66 miles, D yes, E yes, G yes.
Lac Qui Parle—A yes, B yes, D very limited, E yes, many, G some.
Lincoln—A no, C about 15 miles, D yes, E yes, G yes.
Lyon—B none, C Jasper, Minn., D yes, E yes, G yes.
Marshall—A no, B no, D yes, E yes, G yes.
Martin—A no, B no, C Mankato, Minn., D no, E yes, G no, H Mankato.
McLeod—A no, B no, C 60 miles, D yes, E yes, G yes.
Millelacs—A no, B no, C 35 miles, D yes, E yes, G yes.
Nicollet—A yes, at Red Stone, B yes, same as A, C 3 miles at Kasota, D yes, many, E yes, many, G yes, many, H good gravel and sand found along the Minnesota river.
Nobles—A none, B none, C 40 miles, D no, E yes, G few.
Pine—A yes, D yes, E yes, G yes.
Pope—A no, C St. Cloud, 60 miles, D great number, E on every road, G a number.
Redwood—A yes, D no, E yes, G yes.
Roseau—A yes, one, B one, D yes, the county owns 10 pits, E yes, G yes, in all gravel pits.
Stearns—A yes, B no, D yes, E yes, G yes.
Steele—A no, B no, C 16 miles, D yes, E yes, G yes.
Stevens—A none, D yes, G yes.
Swift—A none, B none, C 60 miles, D yes, E yes, G yes.
Wadena—A none known by highway engineer, B none, C St. Cloud, D yes, E yes, G yes.
Winona—A yes, B yes, D yes, E yes, G yes; Note: There are 3 large commercial sand and gravel companies in Winona.

MISSISSIPPI

Adams—A no, B no, D yes, in stream beds chiefly, E yes, G yes, in stream beds chiefly.
Benton—A no, B no, C 60 miles, D no, E no, F 60 miles, G yes, H 60 miles.
Lafayette—A none, B none, C 60 miles, D no, E no, F 40 miles, G yes.
Lee—A none, B none, C 80 miles, D none, E none, F 20 miles, G none, H 20 miles.
Lincoln—A no, B no, C 200 miles, D a washed gravel plant in county, E yes, numerous, G no, H washing plant in county.
Lowndes—A sand-gravel, B red clay gravel, D yes, E yes, G yes.

MISSOURI

Butler—A none developed, D gravel bars in rivers, E yes, G no.
Caldwell—A many, B yes, D no, G yes, in streams.
Carter—A yes, D yes, E yes, G yes, but limited.
Cedar—A no, B no, C not known, D yes, E yes, G yes.
Clark—A none, B none, C 25 miles, D none, E none, F 30 miles, G yes.
Cooper—A yes, B yes, D some, E no, F 200 miles, G yes.
Henry—A none tested, B none tested, D none, F about 30 miles, G none, H Missouri river shipped from Kansas City.
Lincoln—A yes, B yes, D yes, E yes, G yes.
Macon—A very few, B few, C about 70 miles, D none, E none, F about 70 miles, G none first quality, H Mississippi river, 70 miles.
Mississippi—A none, B none, C 35 to 45 miles to satisfactory quarries, D no, E no, F 40 miles, G no, H 40 miles.
Monroe—A splendid limestone in abundance, B plenty of it, a little soft, D small deposits along streams, E not enough to go for, G yes.
Ozark—A yes, B yes, C stone everywhere, D yes, E yes, F in all creek beds, G yes, H on all larger streams.
Perry—A yes, many, B yes, many, D along most streams, E yes, along streams, G yes, many.
Putnam—A no, B no, D no, E no, G yes.
Ralls—A yes, B yes, D yes, E yes, G yes.
Schuyler—A none, B none, C 80 miles, D none, E none, F 80 miles, G none, H 70 to 80 miles.
St. Claif—A yes, limestone, B yes, C all along Osage river, D yes, E yes, F Osage river, G yes.
Sullivan—A yes, D none, G yes.

MONTANA

Beaverhead—A yes, B yes, D yes, E yes, G yes.
Big Horn—A no, B no, D yes, E yes, G yes.
Blaine—A no, B no, D no, E yes, G yes.
Carbon—A deposits for gravel, all parts of county for concrete, B large deposits, D many, all parts, E many, G by screening.
Chouteau—A none, B none, D few only, E few, G yes.
Fergus—A no, D in western part of county, E same as D, G yes.
Flathead—A yes, B yes, D yes, E yes, G yes, H yes.
Granite—A no, but much rock is available, B plenty of rock, D yes, E yes, G yes.
Hill—A no, B no, C 200 miles, D yes, E yes, G yes.
Madison—A Rocky mountains, B yes, abundant supply, D no part of county more than 5 miles from known supply, E ves, G yes, considerable number.
Meagher—A yes, B yes, D yes, E yes, G yes.
Musselshell—A no, B no, D not for road purposes, E yes, but poor quality, G not for concrete roads, H must be shipped in on R. R.
Prairie—A none in operation, D number of gravel deposits for concrete and road surface, F well scattered over county, G yes, H well distributed.
Stillwater—A no, D yes, E yes, G yes.
Teton—A no, B yes, D yes, E yes, G yes.
Valley—A no, B no, C plenty surface rock everywhere—granite, D yes, E yes, G not of the best.
Wheatland—A yes, D yes, G yes.
Yellowstone—A yes, B yes, D yes, E yes, G yes.

NEBRASKA

Antelope—D yes, lots of them, G yes.
Dakota—A no, B one, C 60 miles, D yes, E yes, by crushing, G yes.
Deuel—A no, B no, C don't know, D yes, E yes, F 1 to 3 miles, G yes, H 1 to 3 miles.
Hooker—A none, B none, D yes, E yes, G yes.
Knox—A no, B no, C don't know, D yes, E yes, G yes.
Morrill—A no, B no, D yes, E yes, G yes.
Otoe—A no, B no, C 35 miles, D no, E no, F 35 miles, G yes.
Rock—A yes, B yes, D yes, E yes, G yes.
Saline—A no, B none, C 40 miles, D no, G yes, H all kinds of sand.
Sherman—A yes, some, D yes, E no, F 100 miles, G yes.
Wayne—A no, B no, C Minnesota or lower Nebraska, D no, E no, F 35 miles, G no, H all shipped by rail 100 miles.

NEW JERSEY

Burlington—A no, B no, C 40 miles, D yes, E yes, G yes.
Cumberland—A yes, B no, C 55 miles, D yes, E yes, G yes.
Hunterdon—A yes, B yes, D no, E no, G nothing of any size.
Mercer—A 4, B 4, D yes, E yes, G yes.
Passaic—A 7, B 7, D yes, E yes, G yes.
Southern Division—A yes, B no, C throughout the district, D yes, G yes.
Sussex—A yes, B yes, D no, E yes, F sand concrete 11 miles, G no, H 11 miles.
Union—A yes, B yes, D no, E no, F 30 miles, gravel not used in this county, G no, H 25 miles.

(*To Be Continued*)

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems differently will send us their solutions for publication also: or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

LINING a 20 Foot Well, 50 Feet Deep

Important factors influencing design and operations that require engineering services. General practice in making and placing lining, built monolithic or sectional, resistance to sinking, concrete forms, ballast, methods of excavating, provision for difficulties, underpinning, jetting and sheet piling.

May 12, 1921.

Editor, PUBLIC WORKS.

Dear Sir: We are contemplating the digging of a new city well. this well will be 20 feet inside diameter and 50 feet deep, we intend to curb it with reinforced concrete and use an orange-peel bucket for excavating and sink the curbing with the excavation, the well is to be covered with reinforced concrete.

Will you kindly give me the information necessary for the design of this curbing, showing the thickness of wall and size of steel and distance apart. I am enclosing addressed stamped envelope for reply and thank you very much for your reply.

Yours truly,

Superintendent.

Your letter of May 12 does not give sufficient information for a detailed answer to your question. The thickness of the lining for the well and its reinforcement depend upon several important factors, including the purpose for which the lining shall serve after the completion of the well, the material through which it is to be sunk, and the method by which it is to be sunk.

REQUIREMENTS

If the lining is to serve as the foundation to support a heavy superstructure or to carry machinery, or is to be subjected to vibration or impact, or must be perfectly waterproof, or is to have openings through the sides, these features must be considered in its design.

If the character of the material through which it is to be sunk is unknown, explorations should be made by preliminary borings to determine what is likely to be encountered, and if they are not made, the curb or lining must be constructed with an excess of strength and rigidity to resist hardship in sinking. So far as sinking alone is concerned, a thin, light cylinder might suffice for passing through soft mud that would not answer for more difficult materials, nor be able to withstand the heavy stresses developed if it encounters irregular strata, logs, timbers or boulders.

It must in any event be designed to resist the heavy, unbalanced external pressure and a possible unbalanced internal pressure if it should be filled with water and the ground outside should be dry. It may require a heavy steel or reinforced cutting edge, or a very light one may suffice.

If the excavation is such as can be entirely accomplished by a dredge bucket it should not endanger the integrity of the lining, but if serious obstructions are encountered they may require undermining, heavy chisel work, or even blasting or divers' work, and it may be necessary to undercut the lower edge of the cylinder.

ENGINEERING ADVICE NECESSARY FOR DESIGN

Unless the cylinder is of extraordinary weight, and perhaps not then, its weight alone will not suffice to sink it to the full depth and additional ballast must be provided or supplementary devices like hydraulic jets or compressed air be used to diminish the heavy friction.

The design is therefore a subject that involves careful investigation, study and expert experience which can be properly furnished only by an engineer retained for this purpose. Similar qualifications are necessary for safely and economically executing the work after it is designed. Such services can best be procured from engineers and contractors who specialize in this class of construction, many of whom are members of the principal engineering societies and whose names are found in the advertising pages of the principal technical journals.

PUBLIC WORKS is very glad and ready to give general information or explain novel and standard methods of executing work, but cannot, of course, undertake to make engineering designs for specific cases, or to make investigations and give expert advice that are in the province of the consulting engineer.

INTERIOR EXCAVATION AND UNDERMINING

If the well is for a water works intake, condensation water supply, or other purpose that requires it to be built, as is sometimes the case, in the bed of a lake or river, operations will have to be carried on inside a cofferdam which may often be adapted from the lining itself. It may be wholly or partly built on shore, launched and floated to position and sunk by interior excavation and loading.

If the well is on shore and the ground is very wet it is sunk in much the same way, but without

the use of any cofferdam except what is afforded by the lining itself. Usually it will be possible to "ditch" the lining, that is, to excavate for it in the open down to a little below ground water level, or as far as can be comfortably pumped out, and then build the lining in the bottom of the pit, allowing it to sink by its own weight as the core is excavated by a dredge bucket working under water, as is apparently indicated in the inquiry. For such operations the lower part of the wall should be chamfered on the inside to a very narrow external edge so as to allow the bucket to work as far under the wall as possible and to facilitate the fall of the earth from the exterior under the cutting edge. If, however, local conditions are such as to make any undermining or settlement of the adjacent surface objectionable, this method must be avoided and pains taken to excavate only as much material as is actually displaced by the lining.

If no obstructions are encountered and an orange-peel or clam-shell bucket is used for the excavation, there will be no particular difficulty in excavating below the surface of the water, and considerable advantage will be gained by allowing the water to remain undisturbed in the well during excavation, thus saving the expense of pumping and, in case of encountering quicksand, preventing the development of unbalanced pressure that might cause a large inflow of quicksand and necessitate removing a great deal more spoil than required by the actual volume of the well. If serious obstructions are encountered and it is practicable to pump out the well, it should be done so that men may enter and remove the obstructions; otherwise, the removal by divers and by cutting or blasting under water is likely to be difficult, slow and expensive. Soft material can be removed by a clam-shell bucket; harder material, together with boulders and small timber, even hardpan, can be excavated by a heavy orange-peel bucket. Sand or mud can be pumped out if a suitable centrifugal pump is conveniently available.

SKIN FRICTION AND BALLAST

As the concrete lining proposed may weigh 500,000 pounds and as its descent is opposed by skin friction amounting to perhaps 1,500,000 pounds or more, there may be required 1,000,000 pounds ballast to sink it, an amount which it is likely to be difficult to secure and costly to handle conveniently. The amount of skin friction and consequently the amount of ballast is inversely proportioned to the depth of the open pit in which the sinking is commenced, and it can be cut in half by sinking the lining in two successive sections, a process which requires that the interior diameter of upper section should be somewhat greater than the exterior diameter of the lower section. When this method is employed the lower section can be commenced first and sunk until its upper edge is level with the bottom of the dug pit, after which the upper section can be sunk concentric with it, the material between the two sections washed out with hydraulic jet, and the sinking of the lower section resumed with the elimination of initial skin friction.

The most convenient ballast for loading the lining is generally rails, pig iron, or the like, and special arrangement must be made to apply a large quantity of it without obstructing the dredging operations in the interior.

HYDRAULIC JETS

In sand, loam, or gravel, sinking can be facilitated by providing powerful hydraulic jets around the cutting edge both on the inside and on the outside. In soft materials, if these are numerous and powerful enough they may alone suffice to sink the shell under its own weight to a considerable distance without interior excavation, the core being removed afterwards when it may be possible to seal the bottom, pump out and excavate in the dry.

If the concrete lining is built up to the full height before excavation is commenced, its great weight will expedite the sinking at first, and the operations can be more rapid and continuous throughout. If this is not possible, the shell can be built from the bottom up in successive rings or courses of any convenient height. In either case, steel or wooden forms of the most convenient and economical type can be selected and should be from 5 to 10 feet high, with the outer and inner walls connected by detachable tie rods. They should be slipped up in successive stages with the lower part always engaging the hardened concrete so as to automatically center and support the upper portion for each successive course.

DRY EXCAVATION

If the soil is hard and dry, the orange-peel excavation may be supplemented or replaced by hand work. Obstructions can be removed and the earth excavated under the cutting edge much more advantageously than if the pit is filled with water. If the earth stands up well without disposition to cave in or bleed around the sides of the excavation, it may even be possible to carry the excavation several feet below the lower edge of the concrete lining and to build the concrete lining in successive rings or sections in the bottom adjoining the portion already built, thus underpinning it with course after course. This method is not as desirable as the construction on top so long as the lining sinks freely, but if the friction becomes so great as to stop the sinking, the lower lining can sometimes be advantageously built in this manner.

In very firm soil, such as solid clay, the excavation may sometimes be wholly made before the permanent lining is built, the sides being sheeted and braced temporarily if necessary, and serving as an exterior form against which the concrete can be placed around an interior form only, after the excavation is wholly or partly completed. In such cases the thickness of the lining and its reinforcement would probably be required to be proportioned only to resist unbalanced pressures.

PNEUMATIC CAISSON WORK

If there is possibility of encountering interior obstructions and a large amount of water at a considerable depth and it is necessary to secure access to the bottom of the well, provision should be made in the lining for the application, if necessary, of air pressure to enable the job to be com-

pleted by the pneumatic caisson method. This can be done by leaving recesses in the inner face of the wall about 6 feet above the lower edge, or by building a reinforced annular shoulder there, to take bearing against beams supporting an air-tight deck that can be installed, even under water if necessary, and fitted with an air lock permitting air pressure to be forced in and the work to be completed in the working chamber under the deck. This method should only be used in case of necessity, but preliminary provision for it is very simple and inexpensive. The great objections to this method are the cost of the installation and removal of the air compressing machinery, the delay, and the expensive nature of caisson work. It is, therefore, a method to be used only as a last alternative and is seldom unavoidable.

LINING EXTENDED FROM THE BOTTOM

If by excavating and loading the lining is sunk to clay, hardpan or other hard stratum and will not descend farther, it may sometimes be sealed and permanently supported there and excavation continued to the required depth over the whole area at once, or if necessary in successive sections, and the remainder of the lining built in as a unit, or in courses or sections under the integral upper portion. If much ground water is encountered or the vertical sides of the excavation are unstable, they may be supported by driving slightly inclined poling boards or steel or wooden sheet piling around the circumference with an air hammer or by hand as the core is excavated.

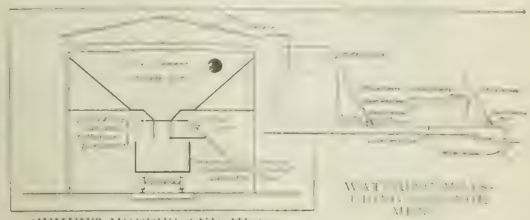
Delivering Bulk Cement and Water to a Concrete Mixer

Recent articles in the "Contractor's Atlas" describe simple and efficient methods of measuring and delivering bulk cement and water to a concrete mixing machine, thus enabling the contractor to expedite and economize the work at the same time that great accuracy was secured without additional trouble. It was found cheaper to unload bulk cement than cement bags, and appreciable losses in bags, and in cement adhering to them, and the cost of transportation of the empty bags were saved by purchasing the cement loose in carload lots for the pavement of more than 5 miles of the Franklin-Isaac concrete road in Virginia.

The cement was transferred from cars to the storage bin by a 36-foot belt conveyor, hooked to the floor at the bottom of the car door. Two men in the car shoveled the cement to the conveyor and handled twice as much cement as six or eight men unloading with wheelbarrows.

The hopper bottom storage bin was provided with a double acting gate valve shown in the sketch, each movement of which measured and discharged exactly 3 bags of cement to the batch box in which the required amount of sand or broken stones had previously been placed.

A simple method for quickly delivering an accurate amount of water to the mixing machine is also shown in the accompanying diagram of an arrangement suited to a limited supply, or where the water is received slowly and there is no regular measuring tank attached to the mixer. The water may be received in a barrel or other convenient reservoir with an overflow, maintained by a float valve, and flow from this reservoir through a short large pipe to the measuring tank provided with a number of small holes half an inch apart vertically, all but one being filled with plugs that are changeable to permit the water to escape at any required height, thus forming a tell-tale to indicate as soon as the tank is filled



CEMENT HOPPER AND MEASURING VALVE

The inlet and outlet pipes are fitted with quick opening valves with long lever handles and when these are set to operate in opposite directions and connected by a pivoted bar, not shown in the sketch, so that one valve is open when the other is closed and vice versa, they can both be instantaneously operated at a single motion and the water delivered to the mixer as soon as the aggregate is placed in the hopper, afterwards the valves remain in this position and are reversed just as the next batch is ready when they are moved back and forth and the operation repeated, and so on.

Sugar Beet Sap Destroys Concrete Roads

Much has been written about the effect of traffic of various kinds, of frost and of other agencies in destroying pavements of different kinds of materials, but from the west comes news of a new source of damage to concrete pavements. In sections where sugar beets are grown in quantity and are transported over the roads to factories it has been found that the sap or juice from the beets is decidedly injurious to concrete pavements. About two years ago County Commissioner William B. Hughes, at Salt Lake City, Utah, was informed by the vice-president of a sugar company in Ogden that "beet pulp juice dripping from wagons is very injurious to concrete roads. Concrete road at Loveland factory of the Great Western Sugar Company was ruined by this means." Similar trouble was experienced at Fort Collins, Colo., and last September the city passed an ordinance providing that "all persons or corporations are hereby prohibited from transporting beet pulp over, across or upon any paving districts or streets within the corporate limits of the city of Fort Collins, or allowing any beet wagons to stand upon said pavements or streets when loaded with beet pulp; providing beet pulp may be transported over, upon and across the streets of the city of Fort Collins when carried in water-tight wagons and not overloaded and the owner and operator of said wagon or wagons has a certificate to that effect from the commissioner of public works of the city of Fort Collins."

Recent Legal Decisions

WATER RATES FIXED BY ORDINANCE SHOULD YIELD REASONABLE RETURN ON INVESTMENT

The California Supreme Court holds, Union Hollywood Water Co. v. City of Los Angeles, 195 Pac. 55, that an ordinance fixing a water rate which would only allow a return to the water company of 1.27 per cent on its capital investment would be in violation of the federal and state constitutions, prohibiting the taking of private property for public use without due compensation and without due process of law. The testimony with respect to the amount that should be allowed as a reasonable rate of interest on investments of this character placed it at from 6 to 8 per cent.

DISCRIMINATION TO CUSTOMER BY ALLOWING FAILURE TO PAY BILLS PROMPTLY

In granting an increase in water rates to the City Water Plant of Fayetteville, Ark., the Arkansas Corporation Commission says: "Like most municipally owned plants, it is operated by a commission appointed by the city council, who do not devote their whole time to the management of the plant. For this reason there is no doubt a looseness in the management of the plant. Especially is this reflected in the evidence before the (Corporation) commission, which shows that various patrons of the plant are several months in arrears in the payment of their water bills, one user, at least, having gone fourteen months without paying his bill. The rules on file with this commission, and the general policy of the commission, is to require prompt payment of all outstanding bills owing to a utility. It is necessary in order to prevent discrimination that these rules must be rigidly enforced. The rules filed are as much a part of the rates as the amounts fixed therein. To allow one customer to violate the rules by not paying his bill promptly is as much discrimination against the other consumers as to give to one customer a lower rate than that fixed by the commission."

COMPETITION BY MUNICIPAL LIGHTING PLANT

A petition by a public utility company showed that the petitioner was the owner of the gas plant in the town of Burlington, Colo., and complained to the Public Utilities Commission that the municipality had, under an ordinance providing for a bond issue for the purpose of extending the water system of the town, constructed and put into operation an electric light plant, and was in competition with the petitioner in the matter of furnishing light. The petitioner claimed that the town had not complied with the statute of 1917, which requires that a public utility shall thereafter obtain from the commission a certificate that public convenience and necessity require the exercise of the right or privilege claimed by the utility. As it appeared from the evidence before the commission that work on the municipal lighting plant was begun before the law became effective, the Colorado Supreme Court, Burlington Gas & Electric Co. v. Commission, 194 Pac. 367, held that the commission's finding in favor of the town was justified.

OWNER JOINING IN PETITION FOR CHANGE OF GRADE STOPPED FROM CLAIMING DAMAGES

The Mississippi Supreme Court holds, Adams v. City of Vicksburg, 86 So. 855, that where an abutting owner signs a petition requesting the city "to grade the street to proper lines and grades," and the city so grades it properly, without objection, the owner is estopped from claiming damages, because the request authorized a change of grade, if proper to make it, and the owner thereby waived his constitutional right to damages.

REGULATING SUPPLY OF WATER TO TENANTS IN BUILDING

In a suit to compel a water company to supply the tenants of a building with water the Vermont Supreme Court holds, Waldron v. International Water Co., 112 Atl. 219, that where there is no general state statute conferring authority to a water company to refuse to deal with tenants of promises which it is under obligation to supply with water, and where the city charter requires the water company to furnish water to the "inhabitants" of the municipality upon terms of equality, the water company has no power to make a regulation requiring owners to pay for water used by tenants and to refuse to sell to tenants. But it is also held that the right of the individual tenant to be supplied with water is qualified by a duty not only to pay or tender the rent charge but also to provide proper means of conveying the water to the tenement occupied by him. The water company's possession ends at the service line, and it cannot be required to provide pipes extending through private property to the several apartments of the block. The water company is entitled to exclusive control of the service pipes at the point of distribution, so that it can supply a tenant who pays his rent without being compelled to supply others who do not pay. In the absence of some materially satisfactory arrangement respecting the means of supply, a tenant demanding water for the portion of the premises occupied by him should bring his own service pipes to the street line. But where the water company has rendered a service to the tenants in a block through a one-pipe system since its inception seven years before without objection, though it could at the outset properly have declined to supply the tenants through a single pipe, the law will imply an agreement to continue the service, at least until such time as by a proper and reasonable regulation it should call upon all its patrons without discrimination to change the means of supply.

NEWS OF THE SOCIETIES

June 13—AMERICAN FEDERATION OF LABOR. Albany Hotel, Denver, Colo.

June 13-14—CLEVELAND SECTION AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Regional meeting Great Lakes Territory. Hotel Statler.

June 14-16. NATIONAL FIRE PROTECTION ASSOCIATION. Annual meeting. San Francisco.

June 15-16. TRI STATE WATER AND LIGHT ASSOCIATION. Asheville, N. C. Secretary, W. F. Seitz, Columbia, S. C.

June 15-17—LEAGUE OF MICHIGAN MUNICIPALITIES. Annual Convention. Kalamazoo, Mich.

June 17. PHILADELPHIA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Outing at Howard McGirl Field.

June 17. INLAND EMPIRE SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Joint meeting with engineering societies of Spokane.

June 17. LOS ANGELES SECTION, SOCIETY OF MECHANICAL ENGINEERS.

June 20. AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Salt Lake City.

June 20-24—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. 13th semi-annual meeting. Detroit, Mich.

June 20-24. AMERICAN SOCIETY FOR TESTING MATERIALS. Annual meeting. Asbury Park, N. J.

June 21-24—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Joint annual and Pacific Coast convention. Salt Lake City, Utah.

June 28. — ATLANTA SECTION AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Election of officers. Georgia School of Technology, Atlanta.

June 28-July 1. — SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, UNIVERSITY OF PITTSBURG. Annual convention. New Haven, Conn.

July 15—NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Annual meeting. Crown Hotel, Providence, R. I.

Aug. 10-12—INTERNATIONAL ASSOCIATION OF STREET CLEANING OFFICIALS. Annual conference Hotel La Salle, Chicago, Ill.

Sept. 13-16—NEW ENGLAND WATER WORKS ASSOCIATION. 39th annual convention. Bridgeport, Conn. Secretary, Frank J. Gifford, 715 Tremont Temple, Boston, Mass.

Sept. 28 (10 days)—NEW YORK ELECTRICAL EXPOSITION. Seventy-first Regiment Armory, New York City.

Oct. 11-14—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual Convention, Atlanta, Ga. Hotel Ansley. Secretary, James J. Mulcahey, Municipal Building, Denver, Colo.

Oct. 24-28—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Southern Hotel, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Nov. 14-18—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

DETROIT ENGINEERING SOCIETY

Joint meeting with Detroit Section of the American Society of Mechanical Engineers and the Detroit-Ann Arbor Section of the American Institute of Electrical Engineers. Address by Messrs. Galusha and Clarke, of Dwight P. Robinson & Co., New York, engineers for the new Colfax plant of the Duquesne Light Company, of Pittsburgh, on "A Mine-mouth Super Power Station," illustrated with lantern slides and moving pictures. Detroit Board of Commerce rooms at 8 p. m.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Annual spring meeting, with sessions of the Forest Products, Fuel, Machine Shop, Management, Materials Handling, Power and Railroad Divisions and General Sessions. At Congress Hotel, Chicago. Preceded by inspection on May 21 of McCook Field, Dayton, and followed on May 27 and 28 by trip to Rock Island Arsenal.

ROCHESTER ENGINEERING SOCIETY

Group meeting. Joseph F. Brightman, local representative of C. A. Dunham Co., will talk on "Steam Heating Systems," illustrating his lecture with lantern slides. Rochester Engineering Society rooms at 8:15 p. m.

ENGINEERS' CLUB OF PHILADELPHIA

At the regular meeting May 19, the General Sales Tax, now pending before Congress with special reference to its bearing on the engineering profession was discussed by Judge L. R. Wilfley, former attorney-general of the Philippines.

At the meeting of May 26 the topic presented was "Meters" from the standpoint of the city engineer, the legislator, the executive, the Lockwood committee, the district attorney and the public, and the establishment of government standards and codes for all materials and appliances was discussed.

ENGINEERS' SOCIETY OF PENNSYLVANIA

The Engineers' Society of Pennsylvania has elected the following officers for the coming year: President, Richard V. McKay; vice-president, Theodore E. Seelye; second vice-president, Crosby Tappan; directors, W. S. Baldwin, Fred Harry and R. Boone Abbott; secretary, Howard E. Moses; and treasurer, Harry T. Neale.

ENGINEERS' CLUB OF PHILADELPHIA

William F. James was elected president of the Engineers' Club of Philadelphia by a majority of 193 votes. He defeated Morris L. Cooke, who had been the choice of the nominating committee. Other officers elected were: vice-president, C. N. Lauer; treasurer, Clayton W. Pike; and directors, Herbert B. Allen and Henry F. Sanville.

AMERICAN SOCIETY OF CIVIL ENGINEERING

At the regular business meeting on June 1, at the rooms of the society, Engineering Societies building, New York City, "A Model Engineer Viewed as a Superior Mechanism" by S. Bent Russell was supplemented by the discussions of C. J. Tilden on "Engineering Ethics"; Rudolph Hering on "Age Improves the Quality of the Model Engineer"; Milo S. Ketchum on "The Professor of Engineering as a Model Engineer"; R. S. Parsons on "The Executive Can Be a Model Engineer"; J. W. McConnell on "The Contracting Engineer Can Be a Model Engineer"; John M. Goodell on "The Engineering Editor Can Be a Model Engineer."

PERSONALS

[illegible] his position.

[illegible] M., has resigned as [illegible] Hampshire [illegible] come highway commissioner of Vermont.

Moss, W. E., has been appointed city engineer of Mt. Vernon, Wash.

Shoemaker, H. P., for eleven years city engineer of Lock Haven, Pa., has resigned to enter private engineering practice.

Clark, B. E., recently acting state engineer of Oklahoma, has now been appointed acting state highway commissioner.

Read, L. C., Jr., has been reappointed city engineer of Sandusky, Mich.

Cooper, W. C., has been appointed city engineer of Kalispell, Mont.

Talbot, W. R., is now engineer for the good roads committee of the Chamber of Commerce, Danville, Va.

Sneed, John L., has been appointed resident engineer for the Virginia State Highway Commission with headquarters at Richmond.

Brown, Norman F., has been appointed director of public works, Pittsburg, Pa., to succeed John Swan, resigned.

Alderman, Ernest S., has been appointed state engineer of Oklahoma.

Tinkham, Samuel E., since 1874 connected with the engineering and public works departments of Boston, died on April 21.

Stanley, George L., has been appointed city engineer of Burlington, Vt.

Kemmish, N. A., has been made city manager of Alliance, Neb.

Edwards, Athol B., of New York City, has been appointed city manager of St. Albans, Vt.

Burley, Ralph J., assistant director and chief engineer of the Reclamation Service in the Department of the Interior, Ottawa, died on April 14.

McCamy, C. C., has been appointed city engineer of Dalton, Ga.

Ford, E. P., has been appointed city engineer of East San Diego, Cal.

Gilmer, D. E., has resigned as county engineer of Reno county, Kan.

McElherne, J. C., has been appointed engineer for Rice county, Minn.

Coleman, Dwight B., has resigned as county superintendent of highways of Cortland county, N. Y.

Robertson, J. D., engineer of highways, Alberta, has been appointed deputy minister of public works.

Parker, G. C., has recently undertaken the duties of acting secretary of the Department of Highways, Ontario.

MacPhee, Neil B., has recently been appointed town superintendent of Port Dalhousie, Ont., to take charge of the water works system.

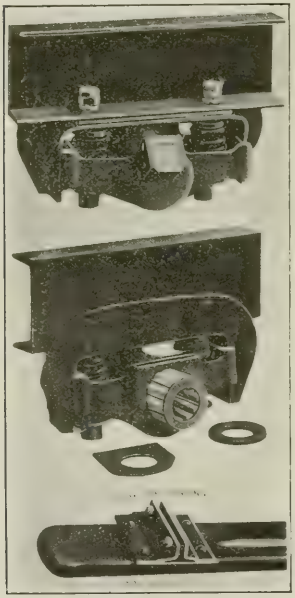
Schneider, Delmont J., has been appointed city engineer and street commissioner of Pocatello, Idaho.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

KOPPEL INDUSTRIAL TRACK AND EQUIPMENT

The Koppel Industrial Car & Equipment Company has put on the market improved sectional industrial railroad track made with 20 and 25-pound standard rails 15 feet long riveted to pressed steel channeled ties with ribbed webs, giving them great stiffness. The end ties have pairs of angle clips riveted to them, giving support to both the webs and the flanges of the rails and provided for bolting the track sections together. The ties are 3½ feet long and 5 inches wide. Several miles of this track are in use by G. P. Scharl, Muskegon, Mich.



PEDESTAL FOR TRUCK WHEEL AXLES

The Koppel Company has also devised a new pedestal bearing for the axles of the wheels in trucks used for the transportation of batch boxes. This pedestal contains a roller bearing, and bolted and riveted to the frame. The trucks can be used not only to carry batch boxes, but also can receive the standard for tilting bodies that transform them into side dump cars.

CRAWLING TREAD LOCOMOTIVE CRANES

The 7 and 12-ton crawling tread locomotive cranes, manufactured by the Orton & Steinbrenner Company, are small machines capable of performing all the functions of large standard gauge rail locomotive cranes without restriction to track facilities. They are suitable for road and excavating contractors, states, municipalities, industrial concerns, coal, sand, gravel and broken stone handling, and surmount obstacles, climb steep grades, run through mud 2 feet deep, turn in a circle of 15 foot radius and unload sand or gravel at a cost of 2 cents per ton. The crawling tread is developed from the government military tank traction, and reduces unit pressure to 10 pounds per square inch. It is adjustable automatically and by set screws.

The cranes are manufactured for operation by steam, electric or gas engine power. They are fitted with 30 or 35-foot booms, or with special booms provided with steam shovel dipper and handle and crowding engine. They will handle a ½-yard to 1½-yard bucket and are made either with crawling tread or road wheels.

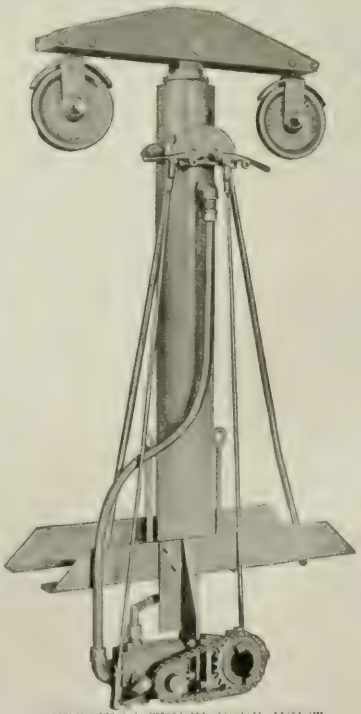
TRUCK HOISTS AND BODIES

The Interboro Hoist & Body Corporation, organized to offer dealers and users complete truck equipment services where a chassis will be equipped completely to meet any requirements, acts as manufacturer and exclusive distributor of platform, stake, high rack, canopy top, express, van and half van truck bodies. Wood hydraulic hoists, all-steel and steel-lined combination wood dumping bodies, hand hoists with dump bodies, cranes and hydraulic hoist services.

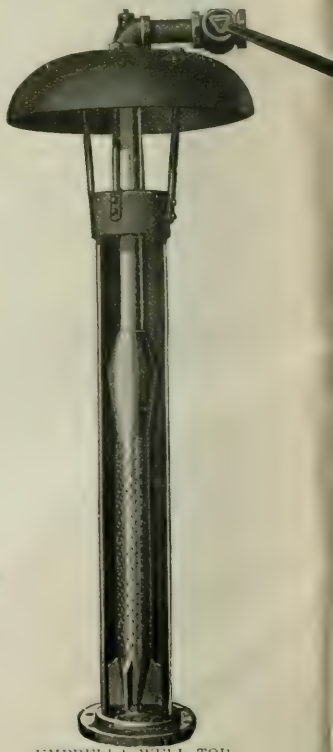
Catalog 2 illustrates many types of platform bodies, including 2-yard and 4-yard dump bodies. Several types and sizes of Wood hydraulic hoists and Meade-Morrison truck winches.

SULLIVAN PUMPS

Air lift pumps, designed and manufactured by the Sullivan Machinery Co., have a central foot piece with an umbrella well top and are provided with strainers to exclude sand from the working barrel of the pump. In order to prevent the clogging of the strainer a method has been developed for displacing the sand close to the strainer with gravel forced down through a pipe driven adjacent to the pump pipe, thus forming a sort of drain which stops the sand and permits the water to flow freely through the strainer. This device is said to often increase the yield of the well 400 per cent.



HYDRAULIC TRUCK BODY HOIST



UMBRELLA WELL TOP

SULLIVAN AIR COMPRESSORS

The Sullivan angle-compound power driver air compressors manufactured by the Sullivan Machinery Co., are illustrated in bulletin 77-B, that deals with three machines of the belted class and two of the direct connected class. These machines, introduced a dozen years ago, are now in extensive use in mines, quarries, shops, water works and on general construction, where it is claimed they deliver more actual compressed air than any other type of air compressor, per unit of power, attention, supplies, installation cost and floor space.

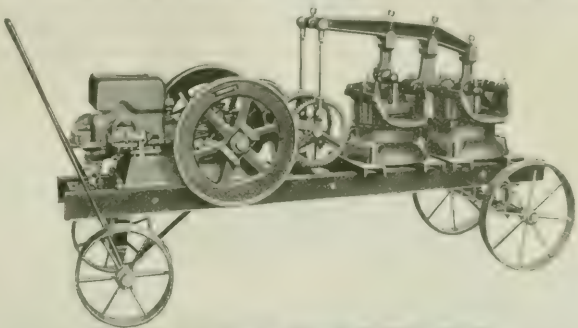
The distinctive features of the angle type compound compressors are that one cylinder with its connecting rod and cross head is almost horizontal, while the other is a high pressure cylinder with its accompanying members is in a vertical plane, and that both are actuated by a single crank. The advantages secured by these features include the balancing of reciprocating forces, small floor space, low cost of installation, low power cost per unit of air compressed, low maintenance cost, flexibility of drive, reduction in care and attention and accessibility. These claims are demonstrated by analysis and illustrated by engravings, made from various pictures of installations and by careful descriptions of the important details of the machine. The construction features include an open hearth steel crank shaft, a band fly wheel made in halves, high and low pressure cylinders with liners placed under hydraulic pressure, air actuated, plate type inlet and discharge valves, a three-pass counter current intercooler with copper or aluminum tubes, stream lubrications for shaft bearings and cross heads and guides, separate oil pumps for the air cylinders. The Class WN-3 compressors are adapted for operation by an electric motor, oil engine or water wheel mounted directly on the crank shaft.

Where more than 1,400 cubic feet of air per minute is required or where the capacity should be variable and elastic within wide limits the Sullivan twin angle compound compressors are recommended. These consist of two single complete compressors set side by side on a common foundation and driven by a common shaft on which is mounted either an electric motor or the belt pulley. These halves of the machine can be installed successively as required or may be detached and operated independently, or one half may be temporarily thrown out of service by closing one of the inlet loaders by hand. If only one quarter of the full capacity is sufficient, one side of the unit is uncoupled and one intake valve removed from the opposite side. For three quarter loads, both sides of the plant would be in commission, but on one side a set of inlet valves would be removed, one from the upper end of the high pressure cylinder and one from the rear end of the intake cylinder. One unit can be cut out leaving the other operating at full load, or one side can be run at full load while the regulation is applied to the other side to meet the demands.

The WI-3 single stage angle compressors compress the air in both cylinders alike from a common inlet conduit or separate inlets as required, the intercooler is omitted, and they are available in single units up to 2,700 cubic feet and for pressures for from 5 to 40 pounds. Air receivers can be provided with capacity of 12 to 376 cubic feet suitable for low pressure cylinder displacements up to 1,000 cubic feet per minute.

JUMBO TRENCH PUMP

The Jumbo diaphragm trench pump for handling large quantities of dirty, gritty water has no complicated parts, no sliding plunger, or cylinder, but two valves and a strong, durable rubber diaphragm with an up and down movement constitutes the pumping mechanism. It is equal to 20 or more men and 12 hand pumps, and is operated at 3 cents per hour per horsepower. It will lift water from 20 to 25 feet by suction, but discharges from the pump by gravity. It has a working speed of 100 r. p. m. and is mounted on a rigid base that may, if required, be placed on standard engine trucks. Either one or two pumps are mounted on the same base and operated by the same engine. It is made in nine sizes, or combination of sizes, with $1\frac{3}{4}$ and 3 h. p. engines with approximate capacities of 1,800 to 12,000 gallons per minute. The net weight varies from 450 to 1,140 pounds and it is manufactured by the Nelson Bros. Co.



DOUBLE DIAPHRAGM JUMBO TRENCH PUMP

P & H EXCAVATOR CRANE 205

The P & H excavator Crane 205 with accessory buckets, manufactured by the Pawling & Harnischfeger Co., is of all steel construction, mounted on caterpillar tractors, and uses gasoline or distillate fuel and provides a complete independent operating unit with no accessory equipment but the buckets. It has a 30-foot boom with ½-yard drag, scraper, clam-shell or orange peel bucket and has a lifting capacity of from 15,200 pounds at 8-foot radius to 3,300 pounds at 30-foot radius. It weighs 14 tons, has a speed of one mile per hour and is equipped with a 40 h. p., 4-cylinder engine with a drag-line pull of 9,500 pounds at a speed of 100 pounds per minute.

Equipped with a Page bucket it will excavate open or sloping bank ditches, clean out old ditches, dig cellars and regular open trenches, and grade streets. Equipped with a self-acting scraper bucket it will follow the largest size trench excavators and backfill rapidly with one man. Equipped with a clamshell bucket it will load or unload coal, crushed stone, sand, gravel, or any other loose material. It will also serve as a locomotive crane operating any kind of hook, hoisting, or grappling device.

The side wheel excavator makes a cut 18 to 20 inches wide and 14 feet deep, suitable for telephone or gas pipe ditches and is so arranged that it can be operated close to the curb at the same time automatically depositing soil on the opposite side of the trench and reducing the time and cost of the work.

The P & H power traction tamper has a 6-foot wheel base, tread of 56 to 80 inches, and a three horsepower water-cooled four-cycle gasoline engine with friction clutch pulley. It will operate on a trench of 30 inches maximum width at the depth of $7\frac{1}{2}$ feet, using a 150-pound ram with a 9 x 12-inch head and a 20-inch stroke. Its road speed is $1\frac{1}{3}$ miles per hour and the feeding speed is 6 feet per minute.

REED ROAD TRACTORS

Tractors manufactured by the Reed Foundry & Machinery Co. are recommended for hauling materials, graders, scarifiers and operating rock crushing machines and for other service in road construction. They are built for performing severe service for many years, and are made in 15-30 and 18-36 sizes, the large size is provided with a 4-cylinder motor and right and left jack shafts driven by independent clutches, obviating the necessity of any differential. The drive wheel has a powerful independent brake, tractors have speeds of $2\frac{1}{2}$ and $3\frac{1}{2}$ miles per hour forward and $1\frac{3}{4}$ miles reverse. The overall dimensions are 70 x 144 inches by 66 inches high, and weight is approximately 6,000 pounds.

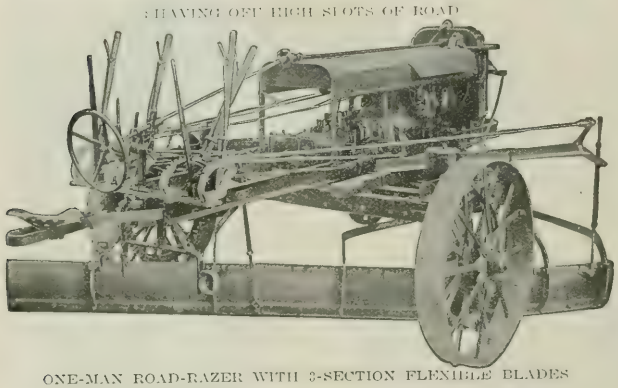
INTERLOCK

Receiving basin, inlet and manhole heads, manufactured and sold by the Interlocking Casting Company, are improved cast iron fixtures of which the covers are at all times interlocked with, and cannot be removed entirely from,

---

The sixty-six pontoons in the Dardanelle bridge, Arkansas, are fastened together and to several intermediate towers by ½-inch galvanized iron Leschen wire ropes 180 to 225 feet long.

SHAVING OFF HIGH SPOTS OF ROAD



ONE-MAN ROAD-RAZER WITH 3-SECTION FLEXIBLE BLADES

ROAD-RAZER

The One-Man Road-Razer, manufactured by the Avery Company shaves off the high spots and fills up the low spots, can be turned in its own tracks with the one castor wheel and has flexible 3 section blades. It has a 6 cylinder motor and 3 speed reverse.

INDUSTRIAL NOTES

REDUCING LABOR COSTS OF CONCRETE PAVEMENTS

In the construction of an 18-foot pavement 8 inches thick at the center on the Chicago-Joliet road, Ill., the contractor, R. F. Conway Company, unloaded sand and stone with clamshell buckets, the stone was hauled in two trucks to storage on the sub-grade where it was loaded by a Barber-Greene bucket loader into a Lee body on a Ford truck chassis that hauled it 50 feet and delivered to the loading skip of a four-bag batch mixer and returned, shuttlewise, without turning around.

Sand and cement for the 1:2:3½ mix were loaded by hand and a crew of 24 men built an average of 430 linear feet of pavement per 9-hour day.

The loading machine replaced 8 shovelers and was operated by one engineer at $1.25 per hour, one helper at 70 cents per hour and consumed 8 gallons of gasoline at 30 cents and one quart of oil at 80 cents, making, with overtime, a total of $20.77, or $0.023 per square yard of pavement, as compared with the cost of $50.40 for eight shovelers doing the same work for $50.40, thus saving $29.63 per day, or $0.033 per square yard. The total amount of pavement laid was 86,000 square yards.

The London Concrete Machinery Co., Ltd., of London, Ont., is to distribute throughout Canada and the British Empire the pumping equipment manufactured by the Aurora Pump & Manufacturing Co., of Aurora, Ill manufacturers of centrifugal pumps of all types, including turbine pumps for deep wells.

The Nova Scotia Steel & Coal Co., Ltd., and the Dominion Steel Corporation, Ltd., have ratified the agreement merging these two companies with Halifax Shipyards, Ltd., the merger to be conducted under the name of British Empire Steel Corporation, Ltd.

D. Henry Bonner, whose resignation from the Ford Motor Co. was recently announced, has joined the Four-Wheel Drive Auto Co. in the capacity of Sales manager. Mr. Bonner went with the Ford organization in 1914 and made rapid progress, holding many responsible positions. At the time of his resignation he was in charge of assembly operations in all of the branches in the United States.

C. J. Reilly has resigned as general superintendent with the Sandusky Cement Co. to take a position as superintendent of the company's plant at York, Pa. His former position will be discharged, for the present at least, by F. G. Herman. C. B. Roger will be sales manager and will be located at the sales office at Cleveland, Ohio.

F. J. Adams has been appointed superintendent of the Bonner Portland Cement Co. at Bonner Springs, Kan., to succeed U. S. Hannum.

G. C. Knickerbocker, formerly chief chemist of the Knickerbocker Portland Cement Co., at Hudson, N. Y., is now with the Great Western Portland Cement Co., Mildred, Kan., as chief chemist.

TRADE PUBLICATIONS

CONCRETE, ITS MANUFACTURE AND USE

4½ x 7 inches, 207 pages, illustrated, bound in cloth. The Koehring Co., Milwaukee, Wis. This attractive handbook for field use has chapters on materials, field operations, highway construction, forms, reinforcing steel, specifications, bridges and culverts, estimating costs, foundations and footings, waterproofing, submerged concrete, and mechanical equipment; tables for estimating and examples for use of them together with miscellaneous notes for superintendents and foremen.

This book is intended to be a guide to the manufacture and placing of concrete in permanent structures and a suggestion on better care of equipment. It recommends proportions and sizes of aggregate for many different kinds of concrete construction, and shows the minimum storage and number of cars of materials required daily to use with different sized mixers on highway construction. It gives valuable information about ordinary causes for difficulties with machinery, and the best methods for caring for it, and is valuable and convenient for every-day use.

SPEED WITH ECONOMY

Barney-Ahlers Construction Co., 110 W. 40th street, New York, issues a 6-page booklet illustrating a number of industrial buildings, coal pockets and other structures that they have recently built with rapidity.

They base their policy on specializing on industrial construction, medium-sized jobs limited to what they can give personal attention in a given territory. They have prepared standard estimate charts, which they offer to send to inquirers, who will inform them of the approximate size of the building contract, the number of stories, floor load and purpose of building.

PUBLIC WORKS.

CITY COUNTY STATE

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Municipal Journal and Engineer Inc
Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879.

Vol. 50 JUNE 18, 1921 No. 25

Repairs to Wood Block Pavement in Newark

By William A. Howell*

These repairs were made necessary by the local destruction of the sand-cement cushion near street railway tracks. In making the repairs, the old base was covered with a wet mortar surface painted with asphalt. A high percentage of the blocks were suitable for relaying after seven years' service

The wood block pavement on Broad street, Newark, N. J., completed on October 1, 1914, having a length of nearly two miles and containing about 80,000 square yards of wood block, one of the most successful wood block pavements ever laid in this country, considering the tremendous traffic it has carried, has again assumed prominence on account of the need of repairs at various points along the line of the pavement. The pavement was originally laid on an 8-inch concrete foundation, with a 1-inch mortar cushion consisting of one part portland cement and 4 parts of sharp sand. The pavement immediately preceding the wood block pavement was a granite pavement on a sand foundation, laid in sections at various intervals from 1879 to 1886. The street railway tracks were laid to accommodate a crown suitable for a granite pavement and therefore required considerable adjustment in order to make the crown as flat as possible to fit in with a wood

*Engineer in charge, Bureau of Paving, Newark, N. J. Member Am. Soc. C. E., A. A. E. and A. S. M. I.

REPAIRED PAVEMENT, BROAD STREET AT N. W. CORNER OF CENTRAL AVENUE
Space repaved, 40 by 10 feet. Photographed June 1, 1921

block pavement. This pavement was described in "Municipal Journal" for October 29, 1914.

The wood blocks were partly manufactured at Mobile, Ala., at the plant of the Republic Creosoting Company, of Indianapolis, Ind., and partly at the local Newark plant of the American Creosoting Company. A very successful expansion joint one and one half inches wide was poured along the curbs and has given great satisfaction.

The blocks were soaked in tubs containing water for ten minutes before laying. The specific gravity of the preservative used ranged from 1.07 to 1.13 and the blocks thus treated weighed 18 pounds to the cubic foot. The blocks furnished by the Republic Creosoting Company were approximately 4 inches wide and 4 inches deep and were laid from South street to Bank street, at the southern end of the work. The blocks from the local plant of the American Creosoting Company were 3 inches wide and 4 inches deep, and were laid on the northerly part of the street, or from Bank street to Belleville avenue. The longitudinal curb grades on Broad street were exceedingly favorable for the laying of a wood block pavement. Not more than 5 per cent of the total yardage was laid on a grade exceeding 2 per cent. More than one-half of the entire yardage was laid on grades not exceeding one-half of 1 per cent. Especial attention was given by the writer to perfect the surface drainage of the street throughout its entire length. More than sixty feet of the old-time wing corner basins were rebuilt, and enlarged, and at least twenty-five new side basins were installed, some at great expense, as the connections had to be laid completely across Broad street. The paving work was not only carefully inspected by veteran city inspectors, carefully selected, but special inspectors employed by the Property Owners' Association were also detailed to watch the construction of the pavement. The preservative did not ooze out of the blocks and give annoyance to the traveling public. On hot days when the preservative was in evidence on the street, the pavement was carefully sanded by the Street Cleaning Bureau and although the residents of Newark are quick to resent any real or imaginary wrongs by rushing to the newspapers, the writer does not recall a single complaint that was registered at the City Hall or in the newspapers of the condition of the pavement during the first three or four years of its history.

CAUSE OF DETERIORATION

No considerable area of the pavement expanded so as to produce trouble. There was a slight expansion near the safety isle at the northwest corner of Broad and Market streets, but it was only local, and after proper repairs had been completed never gave any additional trouble.

The street railway tracks on Broad street, at the time of the construction of the new wood block pavement in 1914, were not reconstructed in a manner to harmonize with the new roadway construction. From the point of view of the street railway company, its representatives did all they thought necessary to put their tracks and track pavement in good condition, but from the point of view of the city, the work of the street railway company was lacking in one important essential, in that the tracks were not made water-tight and waterproof. From Market street to Clinton avenue the Public Service Railway Company in 1914 made no repairs whatever to their Broad street tracks immediately preceding the construction of the new wood block pavement.

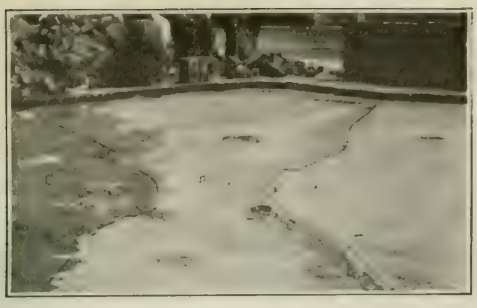
It is true that in 1909 the street railway company had laid one of the most carefully constructed track pavements ever laid in the country on Broad street from Market street to Clinton avenue. In 1914 the company assumed that the tracks and the track pavement needed no additional repairs. This assumption was not correct. The heavy car traffic going over these tracks in five years had caused considerable wear and tear on the ties and consequently a spring of the rails at the joints. In 1909 the track pavement was water-tight, in 1914 it was not.

Within a few months after the completion of the new wood block pavement, the blocks commenced to heave up and buckle in many places immediately adjoining the tracks between Market street and Clinton Avenue. The joints were filled with cement grout to make them waterproof after the Public Service Railway men had tamped the ties, and it was hoped that the trouble had been mastered.

The upward and downward heave or vibration of the rails and ties continued to give trouble, and in time the trouble, instead of being confined to close proximity to the rails, extended from 5 feet to 15 feet from the track. Water got in the track, under the ties, and overflowing got under the blocks and gradually caused the disintegration of the cushion. In some cases the cushion was washed out entirely from under the blocks, and in other instances the original one-inch cushion was increased to 2 or 3 inches, and a depression was thus caused in one place and a corresponding hump in the pavement immediately adjacent.

All of this damage from water was still further increased by the weight of the abnormally heavy war traffic passing over the street during the years 1917, 1918 and 1919. What held good for the condition of the wood block pavement between Market street and Clinton avenue, where the width of the roadway was about 38 feet on either side of the street railway tracks, applied most particularly to that portion of the street north of Market street, where the width of each roadway, especially between Belleville avenue and Bridge street, was not more than 20 feet. On this northerly part of the street repairs had been made by the street railway company in an endeavor to put their tracks in good condition prior to the construction of the wood block pavement, but the repairs, however extensive, were not made as carefully and thoroughly as on that portion of the street south of Market street in 1909. The situation as it exists today is that the pavement is in a bad condition where the track pavement is loose, and in good condition where the track pavement is good.

The wood block pavement is in its worst state of repair at the northern end of the street be-



A—NEW LAYER OF SMOOTH CONCRETE. B—THE ORIGINAL CONCRETE BASE SWEPT OFF. C—DISCOLORATION CAUSED BY WATER AT CATCH BASIN.

tween Bridge street and Belleville avenue, where the roadway is only about half as wide as it is from Central avenue to South street. There are large areas of the Broad street wood block pavement where the pavement is practically in as good condition to-day as when originally laid. On the west side of the street railway tracks alongside of Washington Park, in front of the Prudential Life Insurance Company's building, and along the entire length of Lincoln Park, the pavement is still in almost perfect condition, hardly a block out of place. It is a safe assertion that where the tracks are water-tight the wood block pavement remains good.

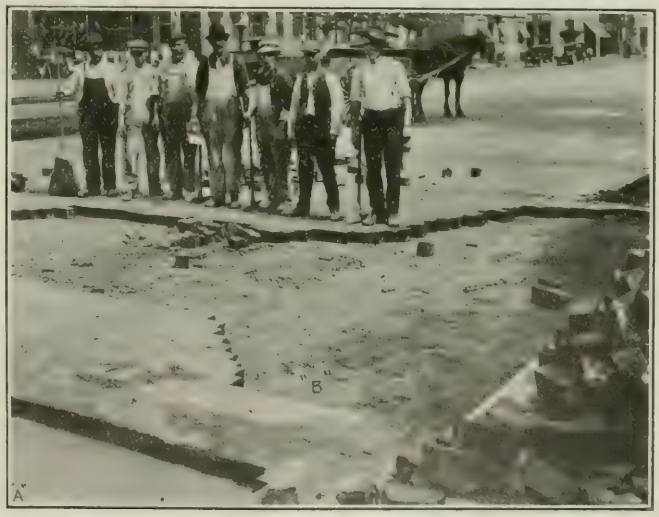
The repairs made by the contractor at the completion of the five-year guarantee period were not altogether satisfactory and the pavement was not finally accepted until 1920. In the repairs made, the contractor simply repeated the method adopted in laying the blocks originally, on a dry mortar cushion slightly dampened with water before the blocks were laid. That this method was not satisfactory soon became evident, the street railway tracks becoming more and more out of repair and the seepage from the rails under the wood blocks making more and more trouble with the cushion. It had been the intention of the writer to make very extensive repairs to the pavement in the fall of 1920, but the lack of funds of the bureau prevented the work from proceeding.

At the conventions of the American Society for Municipal Improvements held at New Orleans in 1919 and at St. Louis in 1920, Supervising Engineer James W. Costello and the writer consulted the most eminent authorities on up-to-date wood block paving in the country, and acting on their advice we are making repairs to the street as follows:

The old mortar cushion, unless in good condition, is scraped off the concrete base. A rich wet mortar strip, very smooth, at least one inch thick, is laid on top of the concrete base and allowed to harden. This strip is composed of one part cement to two of sand. The concrete strip is allowed to harden for at least 3 days, and then is painted with hot asphalt cement having a depth ranging from ⅛ to ¼ of an inch. This coating is allowed to cool, and then the wood blocks are laid thereon, as many of the original blocks being retained as their state of wear will permit. After the blocks have been laid and carefully tamped, hot asphaltic cement is poured in the joints, the pavement is sanded and allowed to stand for at least one day before traffic is allowed to pass over it. This method of reconstruction seems to have handled the situation successfully to date.

The wood block pavement has been repaired from Belleville avenue to Central avenue west of the street railway tracks and has been very much improved in appearance. Repairs recently made to the wood block immediately adjacent to the rails do not last any great length of time, owing to the need of tamping the ties. It is only fair to state that the financial condition of the Public Service Railway Company is common to most street railway companies in the United States at this time. Wages and materials have advanced more sharply than the railway receipts. Public utility commissions have, in many instances, particularly in this state, declined to authorize an increase in fare. In addition to this fact, in the city of Newark the street railroad company has had fierce competition from the jitney buses, which carried 45,000,000 passengers in this city during 1920, diverting over $3,000,000 from the receipts of the street railway company.

In spite of this experience, it would not be correct to say that the mortar cushion laid dry with



A—COMPLETED SMOOTH FINISHED CONCRETE LAYER COURSE. B—REMOVING THE OLD MORTAR CUSHION. AREA OF REPAIR, ABOUT 200 SQUARE FEET.

one part portland cement and three or four parts sand is a failure under wood block pavement.

In the city of the writer, there are miles of wood block pavement in an excellent condition, laid with the mortar cushion. Mechanic street, Mt. Pleasant avenue, High street, Prince street, Roseville avenue, are all in fine condition. Some of these streets have been down nearly ten years. The only failure of the cushion has been on Broad street, caused by the condition of the street railway tracks, and on Passaic avenue caused by the lack of a storm water sewer. It is a safe statement to make that, had there been no street railway tracks on Broad street, the wood block pavement would have been in nearly as good condition as that on Roseville avenue or Mt. Pleasant avenue.

Up to June 10th about 150 depressions in the pavement had been repaired ranging in area from 3 or 4 square feet up to 500 square feet. We were greatly surprised at the large percentage of salvage of old blocks, in some cases running as high as 90 per cent. We started with 75,000 new wood blocks, half of them 3 inches and the other half 4 inches wide and we fully expected to use as many more new blocks before we had gone over the entire street. We have taken care of at least half of the worst depressions in addition to numerous small ones, and we have about 45 per cent. of the original number of our new blocks left.

We have rigidly adhered to our rule not to allow traffic over the newly-repaired spots within four days after the smooth concrete layer had been laid, even where the traffic is the heaviest. Of course we have had to obtain the co-operation of the police department in order to keep traffic away from our work.

We feel that we have made no mistake in using asphaltic cement of the proper penetration for both the paint coat and the filler. It may, and probably will, cost more than pitch in the end, but our experience with asphaltic cement for a year or more on wood block repairs has convinced us that, given a satisfactory smooth concrete, asphalt will outwear pitch, at least on a street carrying such a heavy volume of motor truck traffic as does Broad Street, Newark. We hold no brief for the use of asphalt, but results are what we are after and we are firmly convinced that we are getting them.

Reservoir Roof for Recreation

A few weeks ago we described the construction of a reservoir at Arkansas City, Kan., the flat roof of which is to be used for tennis courts. This city has not a monopoly of this idea, it appears, for in its report for 1920 the Board of Water Commissioners of St. Paul, Minn., states that it expects to build a high-service reservoir, which will be built of reinforced concrete and covered, and the whole property, which consists of 40 acres of land, will then be turned over to the park department for park purposes. It is proposed to have a look-out tower on the reservoir, since an excellent view of the surrounding country can be had from this elevated position. "It is also thought that tennis or other athletic games can be played on top of the reservoir, since it will be quite large and very level."

Low Cost of Road Grading in Nebraska

In the April report of the Department of Public Works of Nebraska is given the following account of how that state obtained low prices for road grading:

In 1918 and 1919, our earthwork cost about 35 cents per yard. In 1920, we were paying an average of 58 cents. Even this high price was lower than surrounding states were paying, for answers received from a questionnaire brought in the following:

State	Price Per Cu. Yd.
Kansas	$ .69
Missouri	.75
Iowa	.66
Colorado	.817
Utah	.75
Nevada	.75
Michigan	.85
Illinois	.80
South Dakota	.80
Ohio	.648
Indiana	.94

It is of interest to compare our average bid price of 58 cents with the average bid price of 75 cents in other states. This meant a saving to the state of 17 cents per cubic yard and on the seven million cubic yards contracted for, made a saving of $1,190,000. This was possible only through careful planning. Early in the spring of 1920 we announced the work which was to be let. At the letting the contractors were very well represented. We had provided that the bids for the contracts which were to be awarded each day were to be filed on the morning of the same day. On opening the bids the first day, we found the average bid price to be about 65 cents per cubic yard. The bids were promptly rejected and the state took the contract at the estimated price, which was 50 cents. On the second day, the average bid was 58 cents, a saving of 7 cents on the yard.

Water Improvement for Washington, D. C.

Congress has appropriated $200,000 with which to begin operations on the construction of a new conduit for bringing water to Washington, D. C.

The present conduit is over 60 years old. As it is the only one bringing water to the city it has not been possible to empty it for repairs of any kind without shutting off the supply, which the authorities are willing to do only in an emergency. It is known that the conduit has deteriorated to a certain extent, but it is impossible to state how greatly until an examination can be made.

The appropriation is made "for the preparation of plans, the initiation of work including the employment of all necessary engineering, technical, clerical and other services." Sixty per cent of this sum will be paid from the revenues of the District of Columbia and 40 per cent from the treasury of the United States.

Designing Improvements in Toledo Sewers

These include intercepting sewers and pumping plants to discharge all the sewage below the city. The article describes at some length the method pursued by the engineers in studying conditions and planning the improvements; also some of the special features of the design itself.

For several years Toledo, Ohio, has had under way plans for improving its sewerage conditions, the investigations and designs having been made by the engineering firm of Fuller & McClintock, of New York. General plans and recommendations were submitted by this firm in 1919, detailed plans prepared, and bids asked in 1920. Contracts for two intercepting sewers were let in January and March. For 18,400 feet of 72 and 66-inch interceptor the contract price was $585,770. For 13,000 feet of 57 and 54-inch interceptor the contract price was $458,826. In June bids were asked on a pumping station and plant. Only a few bids were received, however, and none of these was considered acceptable, and bids were again received on February 15 of this year, when a contract was let for a part of the work. The estimated cost of the projected improvements complete is more than $4,000,000.

Owing to the interest just now in the matter of bids and prices, a comparison is given of those for the pumping station submitted on June 15, 1920, and February 15, 1921. On each of these occasions only one bid was received for the superstructure of the sewage pumping station, the total bid for this having been $127,872 in 1920 and $89,920 in 1921, a reduction of 30 per cent in 8 months. The only other contract bid upon on both occasions was for the sewage pumping equipment. Three bids were received on this in 1920 and 6 bids in 1921. The itemized bids, on some of the principal items of the low bidders on each of these occasions were as follows: Centrifugal motors and pumps, $66,000 and $63,186. Electric hoists for screens, $20,000 and $16,045. Electrically operated gate valves, $12,000 and $10,521. Switchboard, transformers, starters and wiring, $15,000 and $19,569 (an increase). Screens, $10,000 and $6,200. Main suction and discharge piping, $22,000 and $16,618. 36-inch meters, $17,000 and $13,625. Sluice gates, $13,000 and $8,288. The total of all items in the contract was $196,300 in 1920 and $169,182 in 1921, the former bid having been that of the Pitt Construction Company, of Pittsburgh, and the latter that of John R. Proctor Company, Inc., of New York City. The Pitt Construction Company also bid in February of this year, their latter bid being $9,500 lower than their former.

The work contemplated in improving the sewerage conditions of Toledo comprises intercepting sewers to prevent discharge of house sewage into the Maumee river and tributary streams in the city, and two pumping plants, one on each side of the river, to discharge into the river below the city the sewage collected by the interceptors. It may at some more or less distant date be necessary to treat the sewage before discharging it into the river, and while this possibility has been kept in view in preparing the design, it is not believed that treatment will be required for some years and no definite plans for it were made.

The general features referred to are by no means novel, being those found necessary in the majority of such cases, but there are several details that are of considerable interest, and in addition the careful canvass made of existing and anticipated conditions and the scientific analysis of the data so obtained were unusually complete and a brief presentation of their salient features will serve as an excellent illustration of how the study of a problem of this kind is conducted by engineers of the highest reputation.

EXISTING CONDITIONS

Toledo has an estimated population of 254,700, occupying a total area of 15,945 acres. The Maumee river divides it into two main parts known locally as East Toledo and West Toledo, the former having an estimated population of 43,180 and the latter one of 211,520. The topography of the city is such that all of East Toledo drains toward the river while in West Toledo there are three drainage areas, tributary to the river, to Swan creek and to Ten Mile creek, respectively. At present the city sewers, built on the combined plan, drain into these several streams. In times of dry weather the sewage discharged into the creeks produces stagnant pools that are a nuisance and menace to the health of the citizens.

The topography indicated the location of four intercepting sewers, three on the west side of the river and one on the east side. The sewers would concentrate the sewage from the entire city to two pumping plants on opposite sides of the river near the lower boundary of the city. The river here is quite wide and two plants seemed preferable to conducting the sewage from one side across the river to the other so as to operate only one pumping station. In addition, it seemed probable that it would not be necessary to construct the east side intercepting sewer for a number of years and therefore it would be undesirable to provide for east side sewage in estimating the capacity required for the west side pumping station and the outlet therefor. No nuisance is yet caused in the river itself by the sewage discharged into it, although there are evidences of sewage pollution; it therefore seems probable that, when the west side intercepting sewer has removed from the river all of the pollution now reaching it from that side, the effect of the east side pollution will be so comparatively slight as not to demand immediate and costly remedies.

GENERAL FEATURES OF DESIGN

The west side pumping station, known as Bay View Park pumping station, is the one for which bids were received as mentioned above. A river outlet with multiple discharge openings has been designed in connection with this station, but as its construction will probably require much less time than that of the pumping station and equipment, it was thought best not to attempt to place a contract for it until later. In fact, contract was awarded in February of this year for only the substructure, the total low bid for which was $274,789, being that of A. Bentley & Sons, of Toledo. The largest items of this bid were 3,800 cubic yards of concrete masonry at $23.50 a yard, 3,800 cubic yards of earth excavation below elevation 85 at $10.50, and 4,500 cubic yards of earth excavation above elevation 85 at $5.20. A description of the pumping station and some of its more interesting details will be given later on.

It was decided to provide a system of intercepting sewers estimated to have sufficient capacity for conditions anticipated for the year 1960; this included allowing for increase in area of the city, increase in population and increase in per capita sewage. As very little storm water is provided for in the intercepting sewers, possible increase in run-off due to more impervious paving and other conditions did not have to be considered. Owing to the advantage to Toledo of preserving sanitary conditions throughout the water sheds of the creeks passing through the city, whether or no all of the area draining to them might be included within the political limits of the city, provision is made for receiving sewage from portions of these areas that lie outside of the anticipated city limits of 1960.

Not only were the sewers designed to be adequate for 40 years hence, but in a general way a study was made of the possibilities at such future date of providing for the increased capacity that might then become necessary. The engineers did not attempt to definitely plan any special methods of relief for adoption at that future date, since several alternatives seemed to be practicable and it could not be foretold which sewers would first need relief, but study of the problem was made in order that no features of the existing plan might be so designed as to restrict or render unnecessarily difficult the adoption of these relief measures.

The 1960 city limits were assumed to enclose an area of 32,687 acres. Population densities were assigned to various sections of this area which resulted in an estimated population of 711,690. The present average density is 15.9 persons per acre, and the estimated 1960 density figures 21.8 persons per acre within the city limits, or 16.0 per acre over the entire drainage areas considered.

As stated, the sewers at present in use are on the combined system, but it is recommended that in future extensions separate sewers be provided for the house sewage and that these be built with special attention to securing water-tightness, both to avoid overtaxing the capacity of the intercepting sewers and also to reduce needless pumping at the pumping station. It is estimated that by 1960 70 per cent of the total area will be sewered under a separate system.

CALCULATING SEWAGE VOLUME

In calculating the volume of sewage to be carried by the intercepting sewers and by the separate sewers to be built, a distinction was made between sewage from industrial and commercial areas and that from residential areas. This necessitated a forecasting of the use of all the areas of the city; which, in 1960, would be devoted largely to industries, which to commerce, and which to residences. "The availability of rail and water transportation facilities, proximity to a supply of industrial workers and a supply of water for industrial and commercial purposes other than the filtered water of the city, the arrangement of street car lines in the future and contemplated improvements in the business district were factors in determining the location of future industrial and commercial areas."

Over 94 per cent of the water services in Toledo are metered, and it was therefore possible to obtain a very accurate indication of what the domestic water consumption is and from a study of this to estimate the amount of domestic sewage. Additional data of great value were obtained from a water waste survey which was being conducted for the city by the Pitometer Company during the time that this sewerage investigation was in progress. Also, gagings were made on ten large sewer outfalls during the summer of 1916 and 1917, in connection with which a census study was made of the area tributary to each of these outfalls in order to learn, for each, the total population, population connected to the sewers with modern plumbing, population connected with vaults and sinks, population not connected in any way, number of houses, class of dwellings and location of industrial and commercial establishments. A study was made of the water supply statistics for 1917 also.

These data were carefully studied and compared in order to learn existing conditions, and with these as a starting point an effort was made to forecast as closely as possible what the future conditions would be, studying in this connection the bases of design used under similar conditions in making forecasts for other cities.

In studying the water supply statistics, it was assumed that consumers using 100,000 gallons a month or more were either commercial or industrial and those using less than this amount were domestic. On this basis 34 gallons per capita was rated as domestic, 34 as manufacturing, 7 gallons as public use and 17 unaccounted for, the total being 92 gallons per capita.

The meter record of every industrial concern in each of the sewerage districts gaged was investigated. To the quantity of city water sold to these concerns, as shown by the meter records, were added amounts obtained from their private supplies; and from this total, deductions were made for amounts that did not ultimately reach the sewers and the result taken as the average daily quantity of industrial sewage. Similar investigations were made of commercial establishments.

The Pitometer Company during two days in March gaged the flow into a large residential district in which practically every house is provided with modern plumbing, this district containing most of the larger and better class dwellings in the city. A census of this area showed the population to be 20,100. The total average daily flow, after deducting the industrial supply, was 1,010,000 gallons. This gives a domestic consumption of 50 gallons per capita daily. It is assumed that the domestic sewage would be slightly less, or 47 gallons, and that for the city as a whole the average daily discharge would be about 43 gallons per capita per day for those dwellings equipped with modern plumbing.

Since most cities show a marked tendency for increasing domestic use of water with increasing use of plumbing appliances in the residences, it was estimated that by 1960 the water consumption will have increased 21 per cent and the average daily discharge of domestic sewage would be 121 per cent of 43 gallons, or 52 gallons per capita daily.

The investigations above referred to and outfall measurements showed an average daily discharge of industrial sewage of 8,200 gallons per acre per day from one area and 10,100 gallons from another; also 13,350 gallons per acre per day of commercial sewage from the second area (no commercial sewage from the first area); an average of 32 gallons per capita per day of domestic sewage (based on total population within the district) from each of the areas; and 570 gallons per acre per day of ground water from one area and 600 from another.

Maximum Rates.—Investigation was made to determine maximum as well as average rates of water consumption and consequent sewage flow. The waste survey had developed figures indicating that during hot weather about 7 per cent of the average daily consumption was used for lawn sprinkling; this being based upon a comparison of the Pitometer records on clear, hot days with records in the same districts on days during which rain fell.

The average daily pumpages of the public water supply for 1917 and 1918 were investigated, and temperature and weather conditions were investigated for the days showing maximum pumping rates. Maximums occurring on hot, dry days were diminished by 7 per cent to allow for water used in sprinkling lawns and which therefore did not reach sewers. This gave a maximum for winter conditions of 122 per cent of the average for one year and 133 per cent for the other; and for summer conditions gave a maximum of 130 per cent of the average one year and 127 per cent the other. Investigations of the pumpage records for 12 years show that the pumpage on maximum winter days varied from 108 per cent to 133 per cent of the yearly average, the average for the 12-year period being 121 per cent. It was therefore decided to take 125 per cent of the average daily discharge of domestic sewage as the maximum daily discharge, which gave 125 per cent of 52 gallons or 65 gallons per capita daily.

TABLE SHOWING POPULATION TRIBUTARY, TOTAL CAPACITY AND MAXIMUM DRY WEATHER FLOWS FOR INTERCEPTING SEWERS IN VARIOUS CITIES

City	Population Tributary in Thousands	Total Capacity g.c.d.	Maximum Dry Weather Flow g.c.d.
Boston, Mass.	600	258	150
Providence	337	363	145
Milwaukee, 1889	562	419	241
Lynn	...	312	150
Detroit District	...	329	...
Buffalo District	...	482	...
Milwaukee, 1910*	850	350	248
Milwaukee, 1910*	850	350	271
New Bedford	220.7	400	125
Metropolitan High Level Mass. North Metropolitan Interceptor	986 513	500 239	200 ...
Metropolitan Charles River Interceptor	157	224	...
Toledo, Ohio*			
Ten-Mile Creek	312.8	233	198
Swan Creek	207.76	335	230
West Side†	304.76	340	272
East Side	164.27	331	306

*Water supplies nearly 100 per cent metered.
†Flow in Swan Creek interceptor carried through West Side interceptor.

TABLE SHOWING RELATIONS OF INDUSTRIAL, COMMERCIAL AND DOMESTIC FLOW FOR VARIOUS CITIES (Design Basis)

Date of design	1919	1910	1915	1915	1913	1906	1911
Date of ultimate estimate	1960	1950	1940	1950	1950	....	1940
Population in thousands	781,900	862.000	1,500.000	800,000	720,000	230.000	87,200
Industrial area	4,139.05	3,762	4,800	4,065	8,180	622	1,256
Commercial area	837.60	84	700	568	723	66	....
Industrial Q. g. a. d.							
Average, used in design	8.000	9.350	8.000	....	4.500	....	4.444
Maximum, used in design	12.000	16,800	12.000	16.000	9.000	24.000	8.000
Commercial Q. g. a. d.							
Average, used in design	15,000	17,700	33.000	....	....	....	....
Maximum, used in design	30,000	29.800	50,000	60,000	40,000	30,000	....
Industrial Q. g. per 1,000 population							
Average	42.340	40,900	25,600	....	51.000	....	66.800
Maximum	63,510	73.400	38.400	81,500	102.000	....	115.650
Commercial Q. g. per 1,000 population							
Average	16,060	17.400	15.400	....	....	....	....
Maximum	32.120	29.200	23,400	42.600	40.100	8.160	....
Ground water g.-a. d.							
Average	600	1,600	....	....	750	....	....
Maximum	800	1.660	500-1,000	1,000-1,850	750	1.960	....
Domestic Q. gals. per capita							
Average for year	50	50	....	....	....	....	....
Average, maximum days	65	50	114	....	86	100	75
Maximum rate	113*-158*	125	228	285	133	200	150

Note—*Maximum rate depends on population of drainage area.

Further studies were made to determine maximum rates. Hourly readings were taken at the pumping station from one Friday until the following Friday. Sunday showed 87.5 per cent of the daily average for that week, Monday 110.8 per cent, Tuesday 103.9 per cent, Wednesday 99.5 per cent, Thursday 97.4 per cent, Friday, 100 per cent and Saturday 100.9 per cent. The hourly figures showed a maximum hourly Monday rate of 165 per cent of the mean daily rate for the week; but as this included a uniform consumption for industrial and commercial purposes it was not considered a criterion as to the hourly fluctuations in the domestic sewage. "From a study of the investigations made by the Pitometer Company it develops that for an average day the maximum hourly rate of water consumption is 152 per cent of the mean consumption for an average day in those districts which are largely residential. A mean of the gagings of ten sewer outfalls shows a maximum hourly rate of discharge on an average day of 133 per cent of the mean for an average day and also the maximum hourly rate on Monday as 168 per cent of the mean for an average day. These figures include ground water leakage, which is constant, but from them it will be seen that the maximum hourly rate on Monday is 126 per cent of the maximum hourly rate on average days.

"If the maximum hourly rate of water consumption for an average day is 152 per cent of the mean for the day, as shown from the Pitometer measurements, and the maximum hourly rate on Monday is 126 per cent of the maximum hourly rate for an average day, as shown by the sewer gagings, then the maximum hourly rate of domestic water consumption or sewage discharge on Monday is 152 per cent times 126 per cent equals 191 per cent of the average, since the fluctuations in water consumption for domestic purposes and the discharge of domestic sewage may be fairly taken as equal."

Another calculation was made by taking the hourly fluctuations of sewage flow for an average day and for Monday and correcting these for the ground water leakage, which was assumed as constant and had been determined as equal to 600 gallons per acre per day. New hourly rates were thus obtained and expressed as a percentage of the new average, and this gave a maximum hourly Monday rate of 194 per cent of the mean daily rate for an average day.

In the matter of industrial sewage, gagings in the industrial districts showed the maximum to be 140 per cent of the average and the maximum for 1960 was therefore taken as 12,000 gallons per acre daily.

Investigations in commercial districts showed the average daily discharge to be 13,350 gallons per acre daily and the discharge for 1960 assumed to be 15,000 and the maximum as double this or 30,000, since the gagings showed a maximum twice the average.

In determining the ground water leakage, observations were made on the sewer outfalls in the spring when the level of the ground water was high and these indicated the ground water leakage to be 133 per cent of the leakage under normal conditions. Leakage under such conditions had been estimated at 600 gallons per acre per day and therefore the maximum ground water leakage was estimated at 800 gallons. In outlying districts, where it is anticipated that the population density will be low and sewers widely scattered, the ground water leakage was estimated in terms of leakage per mile of sewer rather than per acre. For these it was estimated that the ground water leakage under normal conditions would be 26,000 gallons per mile of sewer and under maximum conditions 32,000 gallons. This estimate was based partly upon observations made in March upon about 11 miles of sewer in one of these districts, where the ground water leakage was found to be approximately 26,400 gallons per mile of sewer.

(To be continued)

Water Department Uses Machinery

In his report for the year 1920, Alfred E. Martin, superintendent of the water department of Springfield, Mass., reported that beginning with the early part of the season a trenching machine and backfiller were used and "have proved a most unqualified success, as we have been enabled to carry on our work efficiently and swiftly with the small gang of men we have been successful in keeping; for the labor question, while not quite so bad as during the previous year, has, nevertheless, not been at all what it used to be, and notwithstanding we have paid the highest wages of any department of the city, only a limited force of men could be maintained.

"In the line of improvement work, our largest job was the laying of a 16-inch main in Boston road from the vicinity of Rosewell avenue to Pasco road, a length of 8,337 feet, and a speed of a little under 200 feet per day was attained with a gang averaging twelve men. This could probably not have been done without the aid of machines above mentioned with a gang of less than 60 to 75 men."

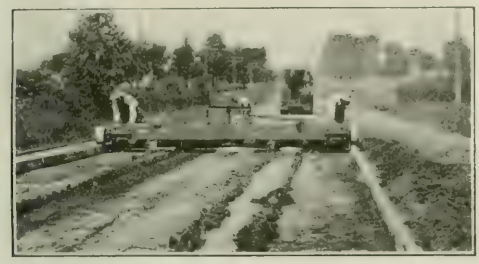
During the year 1920 the Springfield water department replaced 116 service pipes out of a total of 16,328. Concerning this, Superintendent Alfred E. Martin said in his report: "It will be noted that there has been quite a decrease in the number of services replaced this year over those of preceding years, there being something less than one-third as many as heretofore. The reason for the above is the purchase and use of a small tool called the 'Staples Pipe Cleaner,' with which we have been enabled to restore the efficiency of many service pipes which would otherwise perforce have been replaced by new ones; we have thus saved our consumers many dollars as well as ourselves much work, and incidentally the cutting and subsequent repairing of many holes in permanent paving, which of itself is of much benefit to our streets and undoubtedly much appreciated by our friends of the Streets and Engineering Department. This tool costs less than $50 and was purchased upon the recommendation of Mr. Irving H. Henderson, who succeeded Mr. M. L. Miller as foreman of our meter

division, and who had used the instrument very successfully while in the employ of the city of Cambridge in a similar position to that which he holds with us. It has saved our water takers approximately $15,000 during the past year and has thus demonstrated its usefulness and value."

Concrete Highway Construction in South Chicago

Various standard operations adopted on Federal Aid Projects 1 and 2, concrete highways in South Chicago, are illustrated by the following pictures from the files of the Bureau of Roads and Highways of the United States Department of Agriculture.

After the road bed had been approximately graded, the forms were carefully set to line and level for the sides of the concrete slab, the subgrade was accurately trimmed and planed by standard machines hauled by steam rollers that compacted the foundation in advance of them, the whole operation leaving a smooth and uniform surface to receive the concrete.



FINISHING FOUNDATIONS WITH SUBGRADE PLANER

DUMP CAR TRAIN ON SERVICE TRACK ALONGSIDE FINISHED SUBGRADE

MIXING AND FINISHING MACHINES IN OPERATION

CURING CONCRETE PAVEMENT BY PONDING METHOD

Aggregate was delivered from central storage to the mixer by hopper-bottom tilting dump cars hauled on a narrow gauge service track alongside the sub-grade and by wooden batch boxes hauled on flat cars on the service track.

The aggregate was handled by a derrick attached to the frame of the mixer and operated by its engine, which dumped the material into the elevating skip of the mixer and enabled the latter to work continuously.

As the mixer advanced it was followed closely by a finishing machine that compacted and smoothed the surface of the concrete. The finished concrete was cured by the ponding system with two or three inches of water maintained over its surface by low earth or clay dams on the longitudinal edges and connected by transverse dams of the same sort near enough together to offset the water surface in accordance with the grade encountered. Lakewood equipment was installed.

Tempe Bridge Sub-Structure Repairs

Channel pier supporting two 125-foot concrete arch spans settled nearly 11 inches and was underpinned by a reinforced concrete girder supported on groups of cylinder piers sunk to rock both sides of old pier.

The highway bridge across the Salt river, at Tempe, Ariz., has 11 clear spans of 125 feet made with pairs of reinforced concrete arch ribs supported on concrete piers, part of which were carried to rock in open excavation, and part had 11 x 24-foot bases sunk below the river bottom and supported on two 6-foot steel cylinders sunk to rock and filled with concrete. The bridge was completed in 1913 and after a flood in 1919 scoured out some of the sand and gravel around its base, one of the piers settled 4¼ inches, and within a few months settled again ½ inch, and 1⅛ inches, and finally 5 inches more, moving down-stream bodily about 1/10 foot.

Soundings taken after the final settlement showed that the bed of the river had been scoured away down to a thin layer of gravel overlying the solid rock and it was concluded that the concrete deposited under water at the bottom of the two cylinders had been of inferior quality, unable to carry alone the full load on the pier and therefore when the original total bearing surface of 312 square feet on the bottom of the pier was reduced to about 65 square feet on the bottom of the cylinders by the removal of the sand under the overhanging pier base, the greatly increased load on the cylinders was sufficient to buckle the unbraced lower portion of the thin steel cylinder, permitting the bridge to settle.

To support the superstructure, which was not very materially damaged, and to prevent further trouble, it was determined to underpin the upper part of the old pier with new foundations carried down to solid rock outside the old cylinder, thus adding increased support without removing any of the existing support.

After the flood was over, the river began to deposit sediment around the old pier, filling the pit that had been scoured there, but did not prevent the pier from taking another drop, increasing the settlement to a total of about one foot and making it necessary to take the measures to safeguard the bridge.

About 500 sand bags were dumped in the water around the pier to prevent additional scouring, and falsework towers were built under the crowns of the arch ribs of the second spans from the settled pier, at the nearest points where the depth of water permitted it, to support the floor slab, which was continuous except for expansion joints over the crowns of the arches.

The arch ribs in the two spans adjacent to the settled pier were wedged to bearing on falsework trestle bents supported by piles driven beyond the outer edges of the bridge because there was not room to drive them under the arches.

The pier was enclosed by a 30 x 31-foot cofferdam of Wakefield sheet piling driven with a steam hammer and hydraulic jet.

The water in the cofferdam was pumped down to a level not more than 5 feet above the tops of the old cylinders, by an 8-inch centrifugal pump operated by a 40 h. p. gasoline engine.

Three 5-foot steel cylinders were set close to each of the long sides of the pier and were sunk by submerged interior excavation with an orange-peel bucket. They descended easily until they encountered buried driftwood, which was finally cut away with long steel chisel bars after two of the cylinders had been considerably damaged by ineffective blasting with ¼-pound sticks of dynamite.

After passing the obstructions, the cylinders were readily sunk to rock but could not at first be pumped dry on account of the large amount of sand and water entering through the irregularities of the surface of the rock under the bottoms of the cylinders. Attempts to close the holes by grouting the sand were partially successful when the grout was forced in under hydraulic pressure rather than steam pressure. The grout did not, however, all of it set up well, and it finally became necessary to close the openings under the cutting edge by sheet piling made of 6 x 1-inch boards driven by hand inside the cylinder, after the excavation had been carried as far as possible by the orange-peel buckets.

The cylinders were sunk to rock, the surface of which was cleared off and drilled to receive four 1¼-inch square vertical anchor rods grouted in in each cylinder. Two of the cylinders were found to be so badly distorted by the blasting that they had to be replaced by new ones. After the bottoms of the cylinders had been sealed with concrete, the upper part was filled with concrete to an elevation of about 6 feet above the bottom of the old pier base, where the steel shells of the new cylinders were cut off.

Holes parallel with the axis of the bridge were then successively cut through the old base and a wide reinforced concrete girder supporting the entire base of the old pier shaft from the tops of the new cylinders was built in successive sections.

Water Revenues in New London

In the report of the Board of Water and Sewer Commissioners of New London, Conn., for 1920, appears an explanation of a policy adopted by the board which will be of interest to many other cities.

In connection with a move to increase the rates in order to meet increased costs, a committee appointed to study the matter found that during the 47 years covered by the accurate record of the water works, $1,142,400 had been furnished by water consumers to other departments of the city, both public and semi-public. This amount is $209,705 in excess of all payments by the city in interest and appropriations, in behalf of the water works. "It was shown that the water department had partially supported other departments of the city and semi-public institutions for many years. It was developed that many cities charge for all water used by the public and that this practice is advocated by many cities. The states of Indiana and Wisconsin make it compulsory by law. A decision of the Wisconsin Railroad Commission states that the cost of water service should be charged to the city for furnishing water to schools, fountains and other public buildings, and for flushing hydrants, and in case of fire. The commission closes its opinion as follows: 'In other words, private water companies have borne a part of the burden which properly should have been borne by the taxpayers'."

The question was raised whether the water board could lawfully give away any property of the department, including water, and it was decided that it could not. It was also believed unquestionably unjust that water consumers should pay any part of the cost of sewer extensions or maintenance; $118,000 in cash has been contributed by the water department for the support of the sewer department to date.

As the result of this policy, all users of water, including city departments, are charged for the water used at meter rates, except that used through fire hydrants for extinguishing fire and for other public purposes. The board refuses in the future to grant abatements for excessive consumption unless the same is caused by the neglect of the board.

Laying 2,210 Sq. Feet of Pavement Per Day

G. P. Scharl, general contractor, Muskegon, Mich., has broken his own previous record by pouring 1,105 lineal feet of 18-foot concrete road, average thickness 7.666 inches, in nine hours. The work was done on a contract with the Michigan State Highway Department for construction of Sections A and B, Federal Aid Road No. 43, Muskegon county, Mich.

PUBLIC WORKS

Published Weekly
by
Municipal Journal and Engineer, Inc.
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St.,
New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba....$3.00 per year
All other countries .....$4.00 per year

Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

CONTENTS

REPAIRING A WOOD BLOCK PAVEMENT IN NEWARK, N. J.—Illustrated—By William A. Howell 515
Reservoir Roof for Recreation 518
Low Cost of Road Grading in Nebraska 518
Water Improvement for Washington, D. C. 518
DESIGNING IMPROVEMENTS IN TOLEDO'S SEWERAGE 518
Water Department Uses Machinery 519
Concrete Highway Construction in South Chicago—Illustrated 523
TEMPE BRIDGE SUBSTRUCTURE REPAIRS... 523
Water Revenues in New London 524
Laying 2,210 Square Feet of Pavement Per Day..... 524
EDITORIAL NOTES 525
Mortar Cushions for Block Pavements—Water Works Benefit by Adversity—Growth of Registration Areas.
Maximum Immigration 526
Construction Conditions Improving 526
AMERICAN WATER WORKS CONVENTION... 527
STATE HIGHWAY EQUIPMENT 529
HOW WATER WORKS MET COST INCREASES 530
Robert Ridgway Honored 530
HOW CAN ARCH CENTERS BE SUPPORTED?—Illustrated 531
Repairing Bituminous Macadam by the Cold Patch Method 533
Many Building Operations 533
PAVING MATERIALS IN VARIOUS COUNTIES 534
Economy by Kansas Highway Commission 536
Duplex Concrete Highway 536
RECENT LEGAL DECISIONS 537

Water Works Benefit by Adversity

The manner in which water works officials have come through the trials and difficulties occasioned during the past two or three years by the constantly increasing costs of labor and materials required for conducting their departments is greatly to their credit. Most lines of business found it possible to offset, to some extent at least, increased costs by increasing the rates or prices of their own output. The large percentage of water works departments and companies, however, either were denied this privilege or as a matter of policy refrained from advancing rates, endeavoring to meet conditions in other ways. What these ways were in the case of several hundred plants is told briefly in an article in this issue.

Less than one-quarter of the water works increased their rates, and less than one-half of them borrowed money, removed it from their reserve or depreciation funds, or secured it in any other way except by increasing their income.

The most commendable of the various expedients adopted for meeting the increased costs are found in the manner in which superintendents introduced improved methods or plant for reducing operating expenses. These would seem to be of the greatest value not only to these plants but also to others to whom they might well furnish an example, not only because they enabled them to weather this difficult period, but because it seems probable that these same methods can be continued and thus permanently decrease maintenance costs with a corresponding increase in profits to the private concerns or decrease in rates for municipal plants.

The savings already made have been more than absorbed by increased costs, while continued saving for some time to come will be necessary for carrying out improvements and repairs which were necessarily deferred. If, however, these efficiencies and economies are continued thereafter they will constitute a permanent benefit to the plants and prove the truth of the saying that "wise are those who profit by the lessons of adversity."

Mortar Cushions for Block Pavements

The experience of Newark, N. J., with mortar cushion under a wood block pavement, which is described in this issue, is extremely interesting and suggestive. During the past few years this type of cushion has come into more or less general use as a substitute for sand cushions. One of the advantages claimed was that the mortar cushion would not shift under the influences of traffic or other external forces, as sometimes happened where a sand cushion was used. Apparently this was not the case in Broad street, however. The author of the article states that water that got under the block pavement by way of the street railway tracks "caused the disintegration of the cushion. In some cases the cushion was washed out entirely from under the blocks and in other instances the original one-inch cushion was increased to two or three inches, and a depression was thus caused in one place and a corresponding hump in the pavement immediately adjacent."

The writer very explicitly states, however, that this action took place only on certain parts of this street, and that other streets similarly laid, but without street railway tracks, have given perfect satisfaction.

We have noticed similar action in this and other cities and attributed it not only to the admission of water by way of the track but also to the slight vertical movement of the rails. This movement raises the blocks that are in contact with the rails and as each car passes, brings them down suddenly and violently onto the cushion, thus breaking up the cushion and gradually reducing it to the consistency of sand. In the case of Broad street, it is probable that water acted also and finished the deterioration made possible by this breaking up of the mortar. Where there were no

rails the mortar cushion appears to have withstood all the pounding of traffic and maintained the pavement in perfect surface.

Whether the deterioration was due to either of these causes singly or to both combined, the plan adopted by Newark in making its repairs would seem to suggest the means for avoiding such deterioration in original construction. This is, to lay a strip of rich mortar along the edge of the pavement adjacent to the rails, bringing the top of this practically flush with that of the mortar cushion which is to be placed, and after allowing this to set, cover it with a thin layer of asphalt. The mortar cushion would then be spread in the usual way over the remainder of the pavement and the blocks laid as in ordinary construction.

This action of rails and method of using the mortar cushion where rails exist would apply of course to brick and other pavements as well as wood block.

We still have to contend with the tendency of the rails to raise and lower, with a pumping motion, the blocks that are in contact with them. To prevent this, there would seem to be considerable to be said in favor of the use of a thin steel plate placed vertically between the blocks and the rail and immediately in contact with the latter, this plate having a flange at the bottom which is bonded into the concrete base of the pavement. This would permit the rails to slide over the outer surface of the plate without disturbing the blocks, assuming only that the friction between plate and rail was not sufficient to tear the plate from the base or lift the base with the plate. By using a plate not more than one-eighth of an inch thick and set flush or possibly one-eighth of an inch below the surface of the pavement, the plate would not be appreciable to traffic or in any way interfere with it.

Growth of Registration Areas

The federal government has established certain rules for the keeping of vital statistics calculated to secure reliable returns, and states or minor subdivisions that adopt and follow these rules are known as "registration areas." The increasing realization of the importance of vital statistics is indicated by the rapid growth in these areas. This idea was put into effect in 1880, with Massachusetts and New Jersey as the only registration areas. By the 1890 census, Connecticut, New Hampshire, New York, Rhode Island and Vermont had been added, and also Delaware, although this state was dropped from the registration area in 1900. Maine, Michigan and Indiana were added in 1900, and other states in succeeding years until, in 1919, the only states east of the Mississippi not included were West Virginia, Georgia, Alabama, Arkansas and Iowa, and the first of these has recently adopted regulations admitting it to classification in the registration area. In addition, seven of the remaining seventeen states west of the Missisippi are now so included.

Considered from the points of population, the record is even better. In 1919, while states containing 55.5 per cent of the total area of the country were included, these states contained 81.1 per cent of the population. In addition, there were eighteen cities in non-registration states whose returns are accepted by the federal government.

The study of vital statistics is of the greatest importance in various ways, one of the most easily recognized being that of demonstrating the effectiveness of the inauguration and enforcement of health regulations, activities of state boards of health, etc.

It is to be hoped that long before the 1930 census the entire country may be found enrolled in the registration area.

Maximum Immigration

Under the Dillingham percentage immigration law the number or immigrants that can be admitted to this country during the fiscal year, beginning July 1 totaled 77,206 from the United Kingdom, 68,039 from Germany, 19,956 from Sweden, 12,116 from Norway, 42,021 from Italy, 34,347 from Russia, 25,800 from Poland, 14,269 from Czecho-Slovakia, 7,444 from Austria, and smaller numbers from other European countries.

Construction Conditions Improving

A summary of 80 replies received by the Southern Pine Association to a questionnaire sent out by them to the largest cities in this country, indicates that there is an ample supply of building trade labor; that there is a marked increase of labor efficiency; that wages have been decreased in only about one-half of the cities replying; that in these cases the reduction has been from 15 to 20 per cent for carpenters and bricklayers, and from 25 to 55 per cent for common labor.

An average reduction of 35 per cent on retail prices of all staple building materials has been reported from 42 cities, 40 per cent on lumber from 37 cities and 29 per cent on brick from 12 cities. In general, money will only be loaned to 50 per cent of the value of new buildings, and in 46 cities there is a report of shortage of money for building purposes. A general increase in the demand for southern pine lumber is shown by the amount of orders on hand at the mills, which have doubled since the first of the year, and by the reduction of the stock in hand, which has been decreased about 18 per cent since January 1.

A positive indication of better conditions and encouraging progress in construction matters is the report by the Southern Pine Association that the orders for lumber that averaged 694,049 per mill for the week ending April 29 are 20 per cent greater than ever before reported for the corresponding weeks of other years. The next highest figure for the same week was in 1899, when the orders amounted to 576,409. The record for the week ending April 29 is 50 per cent higher than for that of the last week in March.

American Water Works Convention

Narration of the proceedings of the several days. More than seven hundred in attendance. Development of the functions of the Standardization Council. The society's finances. Other features of a most successful convention.

The 41st annual convention of the American Water Works Association, held last week at Cleveland, Ohio, was an unusually successful one from almost every point of view. The program was carried through almost without change, each paper being presented at the time scheduled by the program, with the exception that three papers describing some features of the Cleveland water works were crowded out by lack of time and that two of the papers listed were not received. A decided improvement on former conventions was the beginning of most of the sessions promptly on time. There was little important business conducted at the convention, such as changes in constitution, and no evidences of anything but the most harmonious relations in all matters.

The most popular event, as in previous conventions, was the selection of place of meeting for the next convention. This selection was made by a vote of both the active and associate members at 11:30 on Thursday morning, at which time about 400 members were present in the convention hall. The committee announced that invitations had been received from Baltimore, Detroit, Kansas City, New Orleans, St. Joseph, Mo., Atlantic City, Washington and Philadelphia. The committee, giving first consideration to hotel and convention hall capacity and second to the amount of new work by water departments that would be available for inspection, recommended Baltimore as first choice, with Kansas City and Philadelphia as second. On the first ballot Philadelphia received 148 votes, Baltimore 131, Kansas City 68, New York City 6, Detroit and Atlantic City each 5 and Washington 1. As the regulations of the society require a majority vote, and as it had previously been voted to include in the second ballot, should one be necessary, only the three cities receiving the highest votes in the first ballot, Philadelphia, Baltimore and Kansas City were presented for the second ballot. Kansas City withdrew, leaving only Philadelphia and Baltimore, the former winning by a vote of 197 to Baltimore's 188.

Another interesting procedure of the convention was the election of the nominating committee and the announcement by that committee of its choice for officers for the coming year. On Tuesday noon the members from the various districts got together and made their selections for members of the nominating committee. At the evening session the following were chosen: District No. 1—Pat. Gear; District No. 2—J. Walter Ackerman; District No. 3—William R. Edwards; District No. 4—H. E. Keeler; District No. 5—Ernest B. Black; and District No. 6—F. H. D. Lawlor. On Thursday this committee reported its nominations as follows: For president, W. S. Cramer, of Lexington, Ky.; for vice-president, George W. Fuller, of New York; for trustees—First District, George W. Batchelder, of Worcester, Mass.; and for the Fourth District, Joseph W. Ellms, of Cleveland; for treasurer, William W. Brush, of New York.

At the opening session, Messrs. Carlton E. Davis and Goodell were appointed a committee on resolutions, and at the Thursday morning session they reported a resolution of thanks to the various individuals and associations of the city of Cleveland that had contributed toward making the convention such a pleasant and successful one, which resolution was adopted by standing vote.

Dr. Bartow reported for the executive committee that it had reappointed Mr. Diven as secretary, had appointed Prof. John H. Gregory as chairman of the publication committee and Abel Wolman as editor. Mr. Wolman succeeds Mr. Goodell, who insisted upon the acceptance of his resignation of this position. The society adopted a resolution of thanks to Mr. Goodell and also to Mr. Johnson, the chairman of the finance committee last year, for their services to the society. The finance committee appointed for the coming year is George C. Andrews, J. Walter Ackerman and C. R. Henderson.

The matter of society finances received more attention than any other business feature, membership increase being included under this heading. The finance committee reported that while the expenditures of the year had been $15,136 the income had been only $13,128, thus showing a net deficit for the year of about $2,000, which reduced the cash balance by that amount. The society still holds Liberty Bonds to the par value of $12,000 as an investment fund, but this will be kept intact as long as possible. Even with the increase in dues which goes into effect this year, it will probably be necessary to borrow more or less money for immediate current expenses. Although the expenditures exceeded the income they did not exceed the budget allowance, although it was necessary to transfer certain funds from one account to another, as is permitted by the constitution. The finance committee, in spite of the financial condition of the society, but in view of the great importance which it attached to the work of the Standardization Council, recommended that $2,000 be appropriated for the use of this council in the budget for the coming year. The entire budget as recommended totaled $18,000. The income under present membership and with increased dues would amount to somewhat less than this and the solution for this financial difficulty seemed to be an increase in membership and this was strongly urged on all of the members.

The Standardization Council held a meeting on Monday afternoon previous to the formal opening of the convention and all attending were impressed with the importance of the work that had been done by this council and of the part which this work apparently is destined to play in the future activities of the society. The highest praise was given to the work of this council, of which George W. Fuller was chairman. On Tuesday the council presented its report to the society. This report is a most important document and we are expecting to publish it in our next issue.

It is, we believe, the practice of most societies to direct the president to deliver an annual address at the opening meeting or on the opening day. At this convention President Little's address was delivered at the opening of the Wednesday morning session. Its chief emphasis was placed upon the necessity of increasing the income of this society for carrying on the regular work of the society and that of the new Standardization Council; also suggesting the desirability of providing in some way a source of income for conducting investigations in water works matters. Following the address, and with reference to the point just referred to, Mr. Hazen suggested the possibility that some college might be induced to establish a department of water supply and funds be secured by which such department could conduct investigations referred to by President Little. Somewhat later, in connection with the report of the membership committee, the chairman of that committee Frank C. Jordan, appealed for more individual work by the members for an increase in membership. He referred to Mr. Liesen's success in securing 49 members in one year.

The only unsuccessful feature of the convention, if it can be called such, was the organization of group meetings, as had been suggested in the program; the idea being that members should report to the secretary on Monday morning or before which of several suggested topics they were interested in, and that those interested in each topic might then get together for a round-table discussion. Only three members displayed any interest in the matter and no such meetings were arranged.

The exhibit hall received even more than its usual attention from the members. It was on the same floor with and convenient of access from the convention hall. Seventy-four exhibits had space in the hall, these being as follows:

National Water Main Cleaning Co.
The Pitometer Co.
United Lead Co.
Water Works Equipment Co.
The Mathieson Alkali Works, Inc.
Fire & Water Engineering.
The American City.
Union Water Meter Co.
Eddy Valve Co.
Lock Joint Pipe Co.
Neptune Meter Co.
Thompson Meter Co.
Worthington Pump & Machinery Corp.
The Permutit Co.
Pittsburgh-Des Moines Steel Co.
The Kennedy Valve Manufacturing Co.
Pittsburgh Meter Co.
United Brass Manufacturing Co.
Hays Manufacturing Co.
Hauck Manufacturing Co.
Rensselaer Valve Co.
Engineering News-Record.
Engineering and Contracting.
Birch Pump Valve Co.
Canadian Engineer.
The Central Foundry Co.
The A. P. Smith Manufacturing Co.
Public Works.
S. R. Dresser Manufacturing Co.
Buffalo Meter Co.
American Manganese Bronze Co.
Sullivan Machinery Co.
Electro Bleaching Gas Co.
Builders' Iron Foundry.
Hersey Manufacturing Co.
H. W. Clark Co.
H. Mueller Manufacturing Co.
Glauber Brass Manufacturing Co.
Badger Meter Manufacturing Co.
Lead Lined Iron Pipe Co.
National Meter Co.
Wallace & Tiernan Co., Inc.
Payne Dean, Limited.
W. & L. E. Gurley.
Gamon Meter Co.
R. D. Wood & Co.
Bingham & Taylor, W. P. Taylor, Successor.
E. I. duPont de Nemours & Co., Inc.
Ford Meter Box Co.
The Refinite Co.
Chicago Bridge & Iron Works.
Flower Valve Manufacturing Co.
The Leadite Co.
The Underwood Typewriter Co.
United States Cast Iron Pipe & Foundry Co.
The Chapman Valve Manufacturing Co.
Allis--Chalmers Manufacturing Co.
Columbian Iron Works.
The Garlock Packing Co.
Ross Valve Manufacturing Co.
Simplex Valve & Meter Co.
Layne & Bowler Co.
The New York Continental Jewell Filtration Co.
National Tube Co.
East Jersey Pipe Co.
Neptune Meter Co., Ltd., of Canada.
Continental Pipe Manufacturing Co.
Ambursen Construction Co.
Van Gilder Water Meter Co.
Pittsburgh Filter & Engineering Co.
Addressograph Co.
Chippewa Pump Co.
The Wellman-Seaver Morgan Co.
Austin Machinery Corporation.

What might be considered as an exhibit was given in the audience hall in the form of moving pictures of trench digging by means of Austin and Parsons machines.

The attendance was excellent and notably so on the first day and the last. Before the formal opening of the convention on Tuesday, there had been registered 240 active members, 125 associate members and a considerable number of guests. The program called for the continuation of the discussions of Superintendents' Day from Thursday to Friday morning and it had been predicted by many that Thursday night would see a general exodus and that the Friday morning session would probably not take place. On the contrary, a most interesting meeting and discussion took place on Friday morning with more than 50 in the hall and a considerable number visited the filter plant and pumping station following this session.

The total registration at the closing of the books on Wednesday night was 363 active members, 170 associate members and more than 200 guests.

The social and entertainment features of the convention included an informal reception with dancing on Monday evening, where Mayor Fitzgerald delivered an address of welcome; a smoker on Wednesday evening enlivened with several vaudeville features; a most enjoyable boat ride on the lake on Thursday evening; and a visit in special cars to the filtration plant of the Cleveland water works, where a luncheon was served Friday noon. The ladies were entertained during the week by a trip to the Cleveland Yacht Club on Tuesday afternoon, a shopping trip Wednesday morning, a theatre party Wednesday evening, a card party Thursday afternoon and participation in the boat ride of Thursday evening and the trip to the filtration plant on Friday.

A description of the papers read at the convention and discussions of them by the members will be given next week.

State Road Equipment

Description of plant used by Second Division of New York State Department of Highways.

The Second Division of the New York State Department of Highways, comprising the counties of Albany, Clinton, Essex, Rensselaer, Saratoga, Schenectady, Warren and Washington, contains 1,100 miles of state road, maintained under the direction of Herbert S. Sisson, commissioner, and Harvey O. Schermerhorn, division engineer, with offices in Albany.

Headquarters for storage and repair of machinery, tools and equipment necessary for the proper maintenance of improved highways has been established at Waterford on a plot of ground about 600 feet long and 400 feet wide, situated on the banks of the Barge Canal.

Here there are two parallel 30 x 200-foot storehouses 75 feet apart and enclosing two sides of a rectangular yard, at one end of which is a 40 x 40-foot paint shop and at the other end a 70 x 70-ft. repair shop. All of these houses are built of concrete blocks, the workshops being provided with large windows and ventilators in the roofs, giving ample light and ventilation. The repair shop is equipped with a complete assortment of standard machine tools, such as lathes, drills and the like, operated by electric power, and is so arranged as to accommodate ten or twelve trucks simultaneously for repairs and allowing for removal of any one of them without disturbing the others. The facilities provided are considered ample for the maintenance of fifty or more trucks now in use by this division.

The storehouses provide shelter for six 10 and 6-ton road rollers, twenty Yeager concrete mixers, three special oil distributing machines mounted on automobile trucks, three rotary road sweepers, twelve graders and scarifiers and a supply of small tools and accessories. A gasoline and oil-filling station with hand pumps is also provided at a convenient place for supplying the trucks with fuel and oil.

In a storage yard back of the large workshop is kept a reasonable supply of tile, concrete and cast iron pipe, paving brick, timber and lumber, and pre-cast concrete posts for guide railing and danger and guide signs. This supply is drawn on as needed from time to time throughout the season. One or two carloads of cement is also stored in one of the storage sheds, to be used as needed.

The storehouses and shop are operated by a minimum force of four mechanics, three helpers and one night watchman, under the supervision of a superintendent.

PORTABLE CRUSHER PLANTS

This division is also equipped with a number of stone crushing outfits built by the New Holland Machine Company, of New Holland, Pa., which are used to provide necessary supplies of crushed stone in remote localities where it is difficult to get a commercial supply for macadam or concrete. The products of these plants consist of about 20 per cent of dust suitable for surface treatment cover, 50 to 60 per cent of No. 1 stone measuring ½ inch to ⅝ inch in diameter and the remainder of No. 2 stone measuring ¾ to 1½ inches in diameter.

These outfits are found to be much more economical than larger crushers and are excellent for light repair work and for patching old roads, rather than for new construction. The crushers, screens and elevators are operated by International Harvester Company gasoline tractors. The crushers will receive broken ledge stone or hardheads up to 6 x 12 inches and the whole outfit is easily hauled from place to place by the 20 h. p. tractor. With two men feeding it the crusher has an output of from 20 to 30 cubic yards per day.

DISTRIBUTING SURFACE MATERIAL THROUGH TRUCK CHUTES

Crusher dust, sand or screenings for cover is first distributed along the road by 3-ton trucks provided with power hoist and end-dump bodies which have two hinged gates, one on either side of the rear end, with bottom plates or sills projecting a little beyond the face of the gate so as to deliver the material into a reversible, detachable chute that is connected to the truck at the proper inclined angle so as to discharge on either side of the roadway and deposit the materials either in separate, small piles, or in long windrows as the truck moves along.

This device eliminates the necessity of handling material by shoveling in the unloading operation. The chutes are operated by one man who walks behind the truck and opens or closes the gate, thus permitting the material to be deposited in piles from which it is spread over the fresh oil. The chute is also used in a similar manner for building up shoulders along the pavement. It has been found very satisfactory and economical for oiling and shoulder work.

How Water Works Met Cost Increases

By economy, efficiency and other methods of reducing expenses; by increasing business or rates; by borrowing money; and by other methods.

Among the data contributed by water works superintendents and other officials in response to a questionnaire sent out recently, the replies from which were published in our issue of June 4, was one giving the method of meeting the increased costs of the past three years. The replies to this question proved to be very interesting and instructive, and most of them were suggestive of more detailed consideration than a mere tabulation.

Of those giving definite replies to this question, 275 were municipal plants and 78 were private.

The plants replying might be divided into four classes—those that reduced expenses, those that increased income, those that obtained funds over and above their income by borrowing or otherwise, and those that simply went into debt. A fifth fortunate class reported that being small gravity plants, with no employees, their increases in costs were insignificant.

Among those that decreased expenses, 5 reported having done so by changing the plant from steam to electric power, and one by changing from steam to oil. One reduced fuel cost by method not particularized. Seven managed to secure greater efficiency in the operation of the plant and 12 greater economy. Nine reduced consumption by metering a larger percentage of their services and 1 by a pitometer survey, while 2 decreased the amount of unaccounted-for water and 13 reduced consumption by methods not particularized The greatest number, 37, reduced expenses by curtailing the force of men employed, 19 did less new work in the matter of extensions and improvements than would otherwise have been done, and 2 curtailed in repairs. One frankly stated that it reduced expenses by giving poorer service than formerly.

In order to increase their incomes, 82 plants, or 23 per cent of the total, increased their rates; 23 increased the amount of business done and one developed a water power and sold it for commercial purposes.

Among those that obtained money from sources other than revenues, 61 used money from their surplus, 34 obtained funds from the city treasury, one used a part of its sinking fund, 29 borrowed money by issuing bonds or otherwise, and in 5 cases, presumably where the water works and an electric light plant were operated together, the electric plant carried the deficit. Only 3 plants apparently are to be classed under the fourth heading, one being a private plant which passed its dividends and the other two simply stating that they ran behind.

Several of these replies would seem to indicate that those in charge were of that class who compel success by profiting by the lessons of adversity. For instance, 23, under the stimulus of the hard conditions, managed to increase their business sufficiently to make up a threatened deficit. Increased business of a water company usually means a permanent increase; moreover, it would appear probable that the methods of obtaining such increase developed under this stimulus, once having been learned, will continue to be used to the permanent advantage of the plant. Also, the plant which realized that it had potential water power which could be developed and sold has secured for itself a permanent asset that might have lain unutilized for years except under the impulse of the recent necessity.

It is interesting to note also that 6 of the plants found that by changing from steam to another source of power they were able to save in operating expenses. This also presumably will continue permanently as an economy which might otherwise have been overlooked or at least delayed had ordinary conditions continued. Similarly those that found it possible to obtain greater efficiency and economy by more careful operation or modified methods have undoubtedly learned a lesson by which they will continue to profit. The same applies to those who found it possible to reduce consumption by metering, making pitometer surveys or otherwise.

On the other hand, it is to be hoped that some of the methods of meeting these recent difficulties will be forgotten as speedily as possible by the plants employing them. This includes the using of money from their surplus, but especially the use of money from the sinking fund, which latter use would be illegal in some states and should be in all.

Altogether, it is certainly encouraging that one-third of the plants found it possible to weather the financial storm without either obtaining money from other sources or increasing their rates; and that, including those that made a certainly justifiable increase in rates, more than 60 per cent of the plants have succeeded in pulling through without borrowing money or obtaining it in any other way from outside sources or without curtailing the services.

Robert Ridgway Honored

About 750 engineers, contractors, financiers, municipal officials and guests participated June 9 in a testimonial dinner at the Pennsylvania Hotel, New York City, given in affectionate appreciation to Robert Ridgway, formerly engineer of subways and recently appointed chief engineer of the Transit Commission of New York City.

J. Waldo Smith, chief engineer of the Catskill aqueduct, was toastmaster, and the other speakers were: Hon. George McAneny, chairman of the new transit commission; Hon. Edward S. McCall, former chairman of the Public Service Commission; General J. F. O'Ryan, Transit Commissioner; Wm. Barclay Parsons, the first chief engineer of the New York Rapid Transit and Subway system, and J. F. Galvin, former president of the Board of Water Supply.

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems differently will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

How Can Arch Centers Be Supported?

Directly from the ground; from the substructure, from trusses, from intermediate towers and on trestle work.

During the time that the concrete is being placed and developing at least 75 per cent of its ultimate strength, the forms in which the arch spans are concreted must receive reliable and unyielding support that should be arranged for quick and complete removal, gradually and uniformly and under perfect control. This is generally accomplished by supporting the forms on the structures called arch centers, which, when removed, are said to "struck."

SHORT FRAMED CENTERS

The arch center should support the entire span between skewbacks or between false skewbacks, and should act as a unit both in its function and when it is being removed. For very short spans it is generally made of wood and consists of a rigid framework with a horizontal lower member supported at the ends and, if necessary, at intermediate points. The upper member is curved to correspond with intrados of the arch and to support the lagging or transverse elements of the bottom of the form.

Generally the framework consists of several parallel ribs transverse to the axis of the arch and securely braced together by horizontal and diagonal members. For convenience in short spans the curved upper members of the centers are generally made of three thicknesses of planks breaking joints, and spiked or bolted together to make segmental ribs, the upper edge of which is a continuous arc and the lower edge is formed of straight line chords to the arc. The extremities of the arc are usually connected by a horizontal bottom chord, which, if the span is more than 5 or 6 feet, is generally braced to the different segments of the top chords.

Centers of this type, properly designed, may themselves form trusses adequate to span openings of 15 or 20 feet in the clear and if the top chords are made of square timbers properly jointed and spliced and with a suitable system of bracing and tension rods the length of the span may be increased to 40 or 50 feet and require supports only at the extremities.

TRUSSED CENTERS

For spans of this length or greater it is, however, generally better to provide [illegible]

CONNECTICUT AVENUE BRIDGE, WASHINGTON, D. C. ERECTED ON TRESTLE FALSEWORK ARCH CENTERS AND CONCRETED BY OVERHEAD DERRICK SYSTEM AND LOW LEVEL SERVICE TRACK.

pendent trusses or to make special centering trusses or to support comparatively light centering frames at the ends and at intermediate points. Special trusses may be made to serve as centers if their top chords conform to the curve of the arch soffit and are frequently made, especially for long spans, of riveted or pin connected structural steel members as carefully designed and fabricated as are permanent railroad bridges.

These generally receive the lagging directly on their top chords and are supported from the piers or on falsework bents adjacent to them. They are generally desirable where the elevation of the arch soffit above the ground is very great; where a wide, clear opening must be preserved for traffic or navigation; where the water is very deep or very swift or is subject to flood, heavy ice or drift; or where the bottom is very soft and treacherous or very hard and irregular, making it difficult to install falsework on it.

SUBDIVIDED SPANS

In such cases, however, it may be profitable to subdivide long spans into two or more shorter ones by the construction of temporary towers or supports intermediate between the piers. For this purpose one or more pairs of pile trestle bents securely braced together generally make the most convenient and economical pier where their use is practicable, but if the bottom is too hard to drive piles they may sometimes be replaced by timber cribs filled with stone and serving for a footing on which framed bents are erected to form the upper part of the tower.

PILE FALSEWORK SUPPORT

If the upper part of the arch soffit is not far above the surface of the ground or of the water, if no wide clearance spaces have to be maintained under it, and if there is no difficulty in installing and maintaining falsework in the water or on the ground, it may be more economical, especially for a single span, to support the arch centering on transverse trestle bents, each composed of two or more vertical posts with or without batter posts at the ends. On solid ground with a good bearing capacity, the trestle bents may be of framed timber with mud sills laid directly on the ground or if the latter is uneven and it is not convenient to level it they may be supported on low blocking or cribbing. If the ground is soft the sills may be laid on grillages of transverse timbers properly proportioned to distribute the load over a sufficiently large bearing area.

TRUSSED CENTER SUPPORTED ON FALSEWORK BENTS FOR NESHAMINY BRIDGE

Framed trestle bents with mud sills may be also used on the river bed if the latter is flat and smooth, but are not suited to an irregular surface. If the water is deep or the bottom soft or irregular it will generally be necessary to support the centering on pile foundations and the piles may be cut off above water level and capped to support frame trestle bents, or if the height is not too great they may be carried up nearly to the intrados and support the centeding directly on their caps, parallel to the axis of the arch.

PILE DRIVING AND BRACING

Piles should be carefully proportioned to the load and to the bearing value of the bottom and should be well driven to satisfactory refusal by a drop hammer, steam or air hammer. Special care should be taken to X brace them thoroughly, both transversely and longitudinally without which they have little stability.

Where a large number of piles are used, unless they are very lightly loaded, they should be driven to a penetration of not more than 1 inch under the last blow of an ordinary 2,000-pound drop hammer falling 10 feet. If this is not possible, the bearing power of the pile should be carefully estimated by the use of any standard pile formula or by an actual loading test, and if any appreciable settlement occurs under double the maximum load that the piles will have to sustain in the construction of the bridge, additional piles should be added.

If this is impossible provision for settlement may be made by putting double caps on the piles and separating them by pairs of folding wedges that can be driven up to compensate for settlement. A better plan on important work is to arrange the double caps with sufficient space between them to permit packing and blocking of the upper cap if necessary.

PROVISION FOR SETTLEMENT

The sills parallel to the axis of the arch, on which the arch centers are supported should always be maintained at the exact required position until the centers are swung and the elevation should be checked daily or oftener if necessary, by careful levels taken on it and on a bench mark and any indicated settlement should be immediately met by operating the adjustments already described.

STRIKING CENTERS

The bearings of the arch centers or arch center trusses on their sills should be made adjustable with wedges, jack screws, or sand boxes arranged to be operated independently of the adjustment for the pile caps and so designed that when the concerte has properly set the centers can be quickly struck by operating the adjustments so as to lower the center uniformly and give it an under clearance from the arch soffit.

Sand boxes are very convenient and satisfactory devices, especially for very heavy spans. They

consist simply of a receptacle open on top and filled with dry sand, the level upper surface of which supports a plunger or pedestal with moderate clearance from the sides of the box, and bearing the bridge load on its upper end. The sand boxes must be protected from moisture, which may be accomplished by sealing them around the plunger and the upper end of the box.

When the arch center is to be struck, small holes are opened at the bottoms of the boxes and the sand is allowed to flow out or is removed by spoons or by small water jets, care being taken to measure the amount uniformly and simultaneously removed from the different sand boxes, stopping the operations by signals as soon as a given amount has been removed, and thus assuring perfect uniformity as the plungers settle to correspond with the removal of the sand.

SHIFTING ARCH CENTERS

If there are several duplicate spans the centering after being struck under the first span can be removed transversely, usually on rollers between it and its sills until it is free of the span and then is moved longitudinally opposite the next span, and transversely back into position on the supports there and used for its construction, and so on for succeeding spans. Centers of moderate lengths can be removed easily by hand, larger and heavier ones are generally removed as units by derricks, cableways or other convenient apparatus installed on the job, and if very large trusses are used they may sometimes be divided into semi-trusses and handled separately, but are generally handled singly or in braced pairs by the plant installed.

Ordinary bridge trusses may be utilized for supporting the centers if they are available. They can be supported on the abutments or on special falsework bents or towers and provided with adjustable bearings on their top chords to support the centering at the ends and intermediately if necessary.

Repairing Bituminous Macadam Highways by Cold Patch Method

The Second Division of the New York State Department of Highways, comprising the eight counties in the northeastern part of the state, contains about 915 miles of road paved with bituminous concrete, repairs on which aggregated during the year 1920 about 400,000 square yards of resurfacing by the cold patch method. The material used in this method consists of asphalt or tar, and stone of the smaller sizes, mainly ⅝-inch and 1½-inch.

The bituminous material is prepared by the manufacturers so that it is of such consistency as to be readily mixed cold with the stone. The mixing is done in small Yeager concrete mixing machines of 7 cubic feet capacity, that discharge two or three successive batches into underslung steel boxes of 20 cubic feet capacity suspended from pairs of wheels.

The tailboard is let down and the mixed material is discharged and spread with long-handle hoes and rakes, after which it is properly rolled, tamped and smoothed to the required finish and soon becomes hard and tough, providing satisfactory repairs that are much more cheaply and conveniently made than if an attempt were made to use hot materials.

The materials are mixed at some convenient place alongside the road and are hauled up to about a quarter of a mile, after which the mixer is moved to a new position. The average repair gang consists of about six men, including a foreman, three or four of the laborers being required to load and dump the mixer, and the remainder to haul the mixture and spread it on the road surface. Under ordinarily favorable conditions, when the work is not too much scattered, a gang will lay about 180 square yards of patches in an eight-hour day.

The amount of work done, of course, depends on the character of the work, such as the location and extent of the holes to be patched, and the average amount of work done in a day will vary more or less according to the conditions. Repair work is carried on in any except wet or freezing weather.

Patching bituminous macadam roads by the above method, using small concrete mixers for mixing the material was originated and developed several years ago in this division, which is under the supervision of Commissioner Herbert S. Sisson and Division Engineer Harvey O. Schermerhorn.

Many Building Operations

In the 27 northeastern states the building operations during the month of May, according to the F. W. Dodge Company's review, amounted to $242,093,000, showing an increase of 9½ per cent over April and about the same amount as in the month of May in 1919 and 1920, although the total amount of building in the same area from January 1, 1920, to June 1, 1920, was nearly $500,000,000 greater than that from January 1 to June 1, 1921.

In May, 1921, the increase in activity would have been greater except for the widespread labor troubles, especially in New England and the middle west. Residential building was 34 per cent, public works and utilities 27 per cent, business building 12 per cent, educational building 10 per cent and industrial building 8 per cent of the total. During the first five months of the year the total investment thus represented by the totaling of contracts let in that period amounts to $839,357,000, being 11 per cent ahead of the preceding five years. During the five months more than $2,000,000,000 of contemplated work has been reported.

To Bridge San Francisco Bay

It is reported that money has been subscribed for a bridge across San Francisco Bay, to cost $25,000,000. The bridge will be 8⅛ miles long, 200 feet wide, and besides providing for traffic of all kinds will carry oil, gas and water pipes and electric conduits for public utility companies. The plans for the structure have been completed and the terminals selected.

Paving Materials in Various Counties

Reports from hundreds of counties throughout the United States telling where contractors can obtain stone, gravel and sand that will be satisfactory to county engineers for use in concrete, macadam and gravel road construction.

(*Continued from Page* 506)

NEW YORK

Broome—A yes, B yes, D yes, E yes, G yes.
Cayuga—A yes, several, B yes, D yes, E yes, G doubtful, one gravel concrete was not a success.
Chenango—A yes, B bituminous macadam, D yes, E yes, G yes.
Franklin—A yes, B yes, D yes, E yes, G yes.
Jefferson—A one commercial, B 2 commercial, C local quarries in all parts, D yes, E yes, G yes.
Madison—A yes, B yes, E yes, G yes.
Monroe—A yes, B yes, D yes, E yes, G yes.
Nassau—A no, B no, C Tompkins Cove limestone, N. Y., D yes, E yes, F commercial gravel plants North Shore, L. I., G yes, H commercial gravel and sand banks, North Shore.
Niagara—A yes, B yes, C some imported, D no, E very little, G yes, H river sand used largely, 25 miles.
Orleans—A yes, B yes, D yes, E yes, G yes, by being washed.
Oswego—A yes, B yes, D yes, E yes, G yes.
Otsego—A yes, lime and sand stone, B yes, D yes, E yes, G yes.
Saratoga—A yes, B yes, D yes, E yes, G yes.
Yates—A yes, B yes, D yes, G yes.

NORTH CAROLINA

Beaufort—A no, B no, C 60 miles, D no, E no, F 125, G yes.
Buncombe—A yes, B yes, D yes, E yes, G yes.
Cherokee—A yes, B yes, D yes, E yes, G yes.
Craven—A no, B no, D no, G yes.
Durham—A yes, B yes, D no, E yes, G yes.
Lenoir—A no, B no, C 100 miles, D no, E no, F 50 miles, G yes, great quantity.
Mitchell—A yes, B yes, D no, E no.
Randolph—A yes, B yes, D yes, E yes, G yes.
Washington—A no, B no, C 100 miles, D no, E no, F 100 miles, G yes, plenty.
Watanga—A yes, B yes, D not in large quantities, E yes, G no, H must be shipped, except small quantities.
Wayne—A none, B none, C 50 miles, D gravel pits, yes, E yes, G yes.
Wilkes—A yes, B yes, D yes, E small amount, G yes.
Wilson—A yes, B yes, D yes, E yes, G yes.
Yancey—A yes, B yes, D yes, E yes, G yes.

NORTH DAKOTA

Barnes—A no, B no, C 300 miles, D yes, E yes, G yes.
Foster—D only a few, E some gravel, but far to haul, F 10 and 20 miles, G some sand, but long haul.
Grand Forks—A no, B no, D yes, E yes, G yes.
Grant—A yes, with crusher, D yes, by screening, E yes, G yes.
Hettinger—A yes, B no, D yes, several, E yes, G yes.
McIntosh—D yes, E yes, G yes.
McKenzie—A no, D yes, E yes, G yes.
Mountrail—A no, B no, C plenty of loose rock, D yes, E yes, G yes.
Pembina—A no, C 200 miles, D yes, E yes, F 5 miles west of Cavalier, sand and gravel, G yes, ridge 1 mile wide and 10 miles long, only one in Pembina.
Pierce—A no, B no, D yes, E yes, G yes.
Ward—A no quarries, boulders can be crushed, B only boulders, C 400 miles, D yes, by screening, E yes, G yes.
Williams—A no, B no, D yes, E yes, G yes.

OHIO

Allen—A yes, B yes, D yes, E yes, G yes.
Ashtabula—A no, B no, C 50 to 60 miles, D very limited amount, E some, G lake sand.
Carroll—A no, B no, C 30 miles for slag, D yes, E yes, G yes.
Champaign—A Greenville Gravel Co., B none, C 50 miles, D yes, E yes, G yes.
Clark—A no, B yes, D yes, E yes, G yes.
Clermont—A yes, B yes, D yes, E yes, G yes.
Clinton—A yes, B yes, D no, E yes, F gravel is 40 miles distant, G yes.
Columbiana—A no, B foundation only, C 40 miles, D yes, Ohio river, E yes, Ohio river, G yes, Ohio river.
Coshocton—A grade A gravel, B some small limestone outcrops, C Marble Cliff, Columbia, 70 miles, 100 miles, D yes, E yes, G yes.
Darke—A no, B yes, D Ridgeville, Ind., 30 miles, D yes, E yes, G yes.
Erie—A yes, B yes, D no, E no, G sand taken from the lake is secured from local companies.
Fairfield—B no, C 30 miles, Columbia, Ohio, D yes, E yes, G yes.
Fayette—A ⅛ of area of county (south part) stone available for macadam roads and concrete, B same as A, D small part, northeast corner of county, also at Washington (central) if developed, G but little.
Fulton—A none, D if screened and worked, E yes, G none, H 100 miles.
Henry—A none, B none, C 35 miles, D none, E none, F 20 miles, G none, H lake sand 40 miles.
Highland—A yes, B yes, D yes, E yes, G yes.
Holmes—A no, B no, C about 100 miles, D yes, E yes, G yes.
Jefferson—A yes, B yes, D yes, G yes.
Licking—A no, B no, C 35 miles, D yes, E yes, G yes.
Marion—A yes, B yes, E yes, G yes.
Meigs—A limestone quarry, B limestone, E Ohio river, H Ohio river.
Ottawa—A yes, B yes, D no, G yes.
Pickaway—A yes, B yes, D yes, E yes, G yes.
Putnam—A yes, B yes, D yes, E yes, G no, H 50 miles.
Richland—A no, B no, C 60 miles, D no, E yes, G yes.
Ross—A yes, B yes, D many, E abundance, F throughout county, G many.
Sandusky—A yes, B yes, D no, E yes, G no.
Summit—A no, B no, C about 90 miles, D no, C yes, G yes.
Trumbull—A no, B no, D no, E yes, G no, H no.
Tuscarawas—A none, B slag plant at Doon, D yes, E yes, G yes.
Union—A yes, B yes, D yes, E yes, G yes.
Warren—A no, B no, C Loveland, Ohio, D yes, E yes, G yes.
Williams—A no, B no, C Holland, near Toledo, 40 miles, D yes, E limited to certain sections, F 30 miles, Indiana or Michigan, G yes, plenty.

OKLAHOMA

Beckham—A no, B yes, D yes, E yes, G yes.
Carter—A no, stone available but not convenient, C 30 miles, D yes, E yes, G yes.
Choctaw—A none open, B none open, D yes, E yes, G no, H 100 miles.
Craig—A yes, D no, G no, H some stone crushed and shipped in for concrete.
Dewey—A none, C not known, D yes, E yes, G yes.
Garfield—A no, B no, C 175 miles to a good one, D no, E no, F 175 miles, G yes.
Grady—A no, B no, C 40 miles, D no, E yes, G yes.
Hughes—A no, B none, C 100 miles, D no, E no, F 100 miles, G none, H 100 miles.
Kingfisher—A no, B no, C about 125 miles, D no, E no, G very few, H Arkansas river sand from Wichita, Kan., 200 miles.
Latimer and Leflore—A no, B no, C Hartshorn cement plant 18 miles from Wilburton, 60 miles Poteau, D yes, E yes, G Arkansas river, north line Leflore county.

Major—A little, C 28 miles, D no, F 28 miles, G very little, H 28 miles.
Oklahoma—A no, B no, C 100 miles, D no, E no, F 35 miles, G no, H 35 miles.
Pottawatomie—A Harjo gravel pit, B no, C 60 miles, D Harjo gravel pit, E Harjo gravel, G 3.

OREGON

Lake—A yes, B yes, D not without crushing, E yes, G very poor sand, H 30 miles.
Marion—A 10, B 10, D no, can be had at river, E yes, G no, can be had at river.
Morrow—A yes, B yes, D yes, E yes, G sand shipped from Umatilla station.
Multnomah—A yes, B yes, D yes, E yes, G yes.
Polk—A yes, B yes, D yes, E yes, G at Willamette river.
Sherman—A yes, B yes, D no, E yes, F 80 miles to Umatilla, G yes.
Washington—A none accessible, B 28, D none has been used, E one operated, G no, H ship in from various points.
Wheeler—A yes, B yes, D yes, E yes, G yes.
Yamhill—A several, B several, D gravel bars on river, E yes, G not very good sand, H Columbia river west 75 miles, Willamette run 50.

PENNSYLVANIA

Armstrong—A yes, B yes, D no, E no, G sand is dredged from Alleghany river.
Erie—A no, B no, D yes, E yes, G yes.
Mifflin—A yes, B yes, D no, E no, F unknown, G eys.
Monroe—A yes, B yes, D yes, E yes, G yes.
Potter—A none, B none, C not known, D no, E no, G no, H not known.
Susquehanna—A yes, B yes, D yes, E yes, G yes.
Warren—A no, B yes, D yes, E yes, G yes.
Wyoming—C 15, D yes, E plenty of them, G yes.

RHODE ISLAND

Bristol—A no, B no, C 9 miles, D yes, E yes, G yes.
Providence—A yes, B yes, D yes, E yes, G yes.

SOUTH CAROLINA

Greenwood—A yes, B yes, D no, E no, F 86 miles, G yes.

SOUTH DAKOTA

Beade—A no, B no, C about 60 miles, D few, E yes, G yes.
Clay—A no, C 80 miles, D yes, G yes.
Codington—D yes, E yes, G ves.
Corson—A no, D yes, E yes, F pits along center of county E & W pit run, G 35 per cent gravel, 65 per cent sand.
Custer—A yes, B yes, D yes, E yes, G yes.
Davison—A no, C about 2 miles east of county line, D yes, E yes, G yes.
Day—A no, field stone available, B no, C 60 miles, Ortonville, D yes, E yes, G yes.
Gregory—A yes, C Gregory and vicinity, D no, E no, G yes, Burke, Gregory, H. Herrick, St. Charles, Bonesteel.
Haakon—A none, B none, C 100 miles, D yes, E yes, G yes.
Hanson—A yes, B yes, D yes, E yes, G yes.
Jackson—A none, B none, C 100 miles, D yes, E yes, G yes.
Lincoln—A no, B no, C 25 miles, D yes, E yes, G yes.
McCook—A yes, B yes, D yes, E yes.
Miner—A unknown, C 30 miles, D great many, E yes, G yes.
Minnehaha—A yes, B yes, D yes, E yes, G yes.
Perkins—A no, B no, C 38 miles, D yes, E yes, G yes.
Spink—A no, B no, C 200 miles, D no, E small amount, F 82 miles, G no, H 82 miles.
Stanley—A no B no, C 160 miles, D no, E yes, G yes.
Sully—A no, B no, D yes, E ves, G ves.
Tripp—A yes, B yes, E yes, G yes.
Union—A no, B no, C 70 miles, D yes, E yes, G yes.
Walworth—A no, B no, C 40 miles, D yes, E yes, G yes.
Yankton—A none, B yes, D yes, E yes, G yes.

TENNESSEE

Bedford, Coffee and Moore—A no, B yes, C 75 miles, D no, E yes, G no, H 75 miles.
Benton—A a number, B none, D plenty, E a number, G yes.
Cocke—A numerous, B numerous, D yes, E yes, G yes.
Greene—A yes, B yes, D no, E no.
Hamilton—A yes, B yes, D from Tennessee river, E yes, G from Tennessee river, H no bank sand.
Lewis—A creek gravel, C 50 miles, D creek and river gravel, G from river and creeks only.
Lincoln—A yes, B yes, D yes, E yes, G yes.
McMinn—A yes, B yes, D yes, E yes, G no, H Lenoir City, 25 miles.
Monroe—A yes, B yes, D no, E very little, G very little, H 75 miles.
Robertson—A yes, B yes, C 2 miles, D yes, F near all roads, G yes, H convenient.
Tipton and Lauderdale—A no, B no, C 150 miles, D no, E yes, F 100 miles, G river and sand near Covington.
White—A yes, B yes, C in county, D no, E no, F 28 miles, G yes, H in county.

TEXAS

Aransas—A no, B no, C 75 miles, D no, E no, F 75 miles, G no, H 75 miles.
Bosque—A yes, B yes, D yes, E yes, G yes.
Callahan—A none open but good locations, B same as A, D no gravel bank located as yet, E yes, G yes.
Cameron—A none, B no, D no, E no, F 100 miles, G no, H 300 miles.
Carson—A no, B no, C none near, D no, E no, F 5 miles, G yes.
Colorado—A yes, 3, B yes, 2, D yes, E yes, numerous, G yes.
Comanche—A yes, B yes, D yes, E yes, G yes.
Dickens—A yes, B yes, D yes, E yes, G yes.
Edwards—A no quarries, but plenty of stone, D very little gravel, G none, but small quantities of sand can be obtained from river beds. It will be necessary to use crushed stone screenings for sand.
Fort Bend—A no, B no, C none near, D yes, but not being worked, E same as concrete gravel, F present sources, Colorado county, G yes, but not worked, H present source, Colorado county.
Gonzales—A yes, D yes, E yes, G yes.
Harris—A no, B yes, C 125 miles, D no, E no, G no.
Hill—A no, B yes, D no, E yes, G no, H 60 miles.
Johnson—A not near enough transportation, B yes, but too yar from transportation, C about 75 miles, D only limited quantities, E yes, G none, H about 40 miles.
Limestone—A one, B one, D no, E no, F 75 miles, G no, E 75 miles.
Madison—A yes, B no, D no, F 40 miles, G yes.
Milam—A yes, B yes, D yes, E yes, G yes.
Montague—A none, B none, C 20 miles, D sand only, E yes, G yes.
Rockwall—A no, B no, C 100 miles, D no, E no, F 40 miles, G no.
San Augustine—A no, B no, E yes, G no.
Shackelford—A yes, B yes, D limited amount in beds of streams, E plentiful, G limited amount in beds of streams.
Tarrant—A no, B no, C 50 miles, D yes, E yes, G yes.
Trinity—A yes, B yes, D yes, E ves, G yes.
Wise—A 1 near Chico, B none, but banks, D none, but some ore used, E numerous, G yes.

VERMONT

Bennington—A yes, B yes, D yes, E yes, G yes.
Burlington—A yes, 2, B yes, D yes, E ves, G yes.
Orange—A ves, B yes, D yes, E yes, G yes.
Windham—A none developed, B none developed, C 30 miles, D yes, E yes, G yes.

VIRGINIA

Augusta—A yes, B yes, D no, E no, G no, H Meechums river, about 30 miles.
Brunswick—A 2, B 2, D none, E yes, G yes.
Campbell—A yes, 5, B yes, 5, D no, E no, F 100 miles, G sand in streams, very plentiful, H 100 miles.
Fairfax—A yes, northwest part, B yes, northwest part, D yes, a few, E yes, numerous, G yes, extreme southeast, H river sand and gravel at Washington or Alexandria.
Nansemond—A no, B no, C 200 miles, D yes, E yes, F 20 miles, G no.
Pittsylvania—A yes, one, B one, D no, E no.
Scott—A yes, B yes, D yes, E yes, G yes.

WASHINGTON

Adams—A yes, B yes, D yes, E yes, G no, H sand shipped 74 miles.
Benton—A yes, B yes, D yes, G yes.
Clallam—D yes, E yes, planty, G yes.
Clarke—A yes, B yes, D no, E yes, F concrete gravel in river, 25 miles, G no, H concrete sand in Columbia river, south boundary of county.
Grant—A yes, B yes, D yes, E yes, G yes.
Island—A no, B no, D yes, E yes, G ves.

Jefferson—A yes, but not in operation, B same as A, D yes, E yes, G yes.
Lincoln—A yes, D yes, E yes, G yes.
Okanogan—A yes, B yes, D yes, E yes, G yes.
Pacific—A none, B none, C 50 miles, D no, E yes, F 50 miles for concrete gravel, G no, H 50 miles.
Skamania—A yes, B yes, D yes, E yes, G yes.
Snohomish—A yes, B no, C 40 miles, D yes, E yes, G yes.
Wahkiakum—A not known, B plenty, D several places, G plenty in Columbia river.

WEST VIRGINIA

Boone—A yes, B none, D yes, E yes, G plenty.
Brooke—A in southern part of county, B same as A, D yes, E not used, G yes.
Cabell—A yes, B all sand stone, D yes, E yes, G yes.
Calhoun—Materials have not been tested sufficient to answer questions.
Hardy—A yes, B yes, D yes, E yes, G yes.
Mercer—A yes, B yes, D no, E no, F 40 miles, G no, H 40 miles.
Mineral—A yes, B yes, D yes, E yes, G yes.
Morgan—A yes, B yes, D no, E no, F don't know, G no, H generally get sand from Washington, D. C.
Nicholas—A no, B no, C 100 miles, D few local deposits in creek beds, G some river sand.
Ohio—A yes, B yes, D yes, Ohio River, E yes, G yes, river.
Pocahontas—A yes, B yes, D yes, E yes, G no, H 120 miles.
Randolph—A yes, B yes, D no, E no, F 175 miles, G no, H 175 miles.
Summers—A 2, B yes, C 30 miles, D no, E yes, F 1.5 miles, G no, H 30 to 50 miles.
Taylor—A hard sand stone, D no, F Ohio river 103 miles, G very small quantities, H Ohio river sand used mostly.
Wayne—A not very satisfactory, B only fair, C reasonably close, D none, E none, F imported, G Pole creek sand is chief supply, H best to import material.
Webster—A no, B no, C 15 miles, D yes, E yes, G yes.
Wetzel—A yes, B no, D yes, E yes, G yes.

WISCONSIN

Adams—A no, B no, C 30 miles, D yes, but 8 miles from R. R., E same range of banks, G no, H 45 miles.
Bayfield—A one, B one, D yes, E yes, G yes.
Buffalo—A yes, 2, B yes, 2, D one, E one, G yes.
Calumet—A yes, 2, B yes, 2, D no, E 5, G no, H 18 miles.
Dunn—A yes, B yes, D yes, E yes, G yes.
Forest—A yes, B yes, D yes, E yes, G yes.
Grant—A yes, B yes, D no, G yes.
Iron—A no, B no, D yes, E yes, G yes.
Jefferson—A yes, B yes, D no, E yes, G yes.
Juneau—A yes, B yes, D no, E yes, F 30 miles, G yes, H 3 or 4 miles.
LaCrosse—A yes, B yes, D no, E no, G yes, H less than ¼ mile from railway.
LaFayette—A yes; B yes, C 75 miles, D no, E no, but tailings, G tailings.
Lincoln—A yes, lots of them, D yes, E yes, G yes.
Portage—A no, B field rock, D yes, E yes, G ves, H several pits within a mile of rock.
Sauk—A yes, B yes, D yes. E yes, G yes.
Trempealeau—A yes, B yes, D no, E yes, G yes.
Vernon—A yes, B yes, D no, E no, F Winona, Minn., G yes.
Waushara—A yes, red granite, B yes, D yes, E yes, G yes.

WYOMING

Natrona—A yes, D yes, E yes, G yes.
Weston—A no, B no, C Edgemont, river gravel, D yes, Cheyenne river, E no, G yes, same place, H Edgemont, S. D.

Economy by Kansas Highway Commission

Under date of June 3 the Kansas Highway Commission sends a notice to engineers and contractors working for or in connection with it that on account of reduced appropriation certain economies in both expenditure and work performed will be put in effect at once. Among other improvements, no telegraph messages will be received except where charges are prepaid by the sender and "it will be necessary that we refrain from the use of long distance telephone or telegraph service except in emergencies." Also because, we presume, of a compulsory reduction of the force, subjects brought before the commission in any way will be considered in the order of their importance, which order it states as follows. 1—Federal Aid Construction. 2—Federal Aid Plans. 3—State Aid Construction. 4—State Aid Plans. 5—Original County Bridge Plans. 6—Railroad Grade Crossing Elimination and Protection. 7—Original County Road Plans. 8—Federal Equipment. 9—Changes in County Road System. 10—Alternate Bridge Plans. 11—General inquiries and miscellaneous matters.

Duplex Concrete Highway

About 2,000 lineal feet of duplex concrete pavement was laid last year by the departmental forces near the southern line of Rensselaer county, in the Second Division, New York State Department of Highways, under the design and supervision of Harvey O. Schermerhorn, division engineer.

This roadway has two 9-foot strips of concrete, 7 inches thick, reinforced by steel mesh weighing 25 pounds to the square yard, and separated by a 6 feet wide strip of bituminous macadam.

It was built at a cost of about $50,000 per mile at the peak of post-war prices. Since then prices on materials and labor have been reduced considerably and the cost per mile for this type of road if built this year would be decidedly less.

The materials were delivered by trucks and dumped in small piles along the subgrade and then handled by wheelbarrows, the work being done in the usual manner, with standard equipment.

Results have so far been considered very satisfactory, justifying all expectations of an extensive use of the same type of roadway in the future. From a construction standpoint the advantages of this duplex pavement over a single type pavement are, the ease with which it is built in separate longitudinal portions, allowing one side of the road to be under construction while traffic on the opposite side is unimpeded; and permitting old roads to be rebuilt without interruption to

From a traffic standpoint on the completed road traffic or provision for detours.
it is an ideal pavement, as the traffic in opposite directions is automatically divided and kept well separated by the distinctive colors of the pavement, the black asphalt in the center setting off in sharp contrast the white concrete on either side.

There is always room between the lines of vehicles for the faster moving ones to pass in front of the slower ones by turning out to the center of the roadway and running over the bituminous macadam, the latter therefore receiving very much less travel than the concrete, is able to stand up well under it, assuring a hard, satisfactory surface equal to all requirements and at a decidedly less cost than the all-concrete pavement.

At night the contrasting colors of the concrete and the bituminous macadam is so great that the two concrete tracks are sharply defined and more easily seen in the dark, thus assisting drivers to keep to the track, almost obviating danger of head-on collisions.

Recent Legal Decisions

DISPOSAL PLANT FOR PORTION OF CITY SEWAGE HELD LOCAL, NOT PUBLIC IMPROVEMENT FOR ASSESSMENT PURPOSES

In holding a disposal plant for a portion of city sewerage to be a local and not a public improvement, and therefore to be paid by private assessment, the Illinois Supreme Court, City of Elmhurst v. Rohmeyer, 130 N. E. 761, took into consideration the fact that the city had previously constructed a similar system of sewers connected with a disposal plant in another district of the city, and the property owners in that district paid for the disposal plant as a local improvement by special assessment. It would therefore be unjust now to call upon the property owners of the first district to contribute to the payment of this second disposal plant after having already paid for their own in their district.

The test whether or not an improvement is local depends upon the question whether or not it specially benefits the property that is specially assessed. Northwestern University v. Village of Wilmette, 230 Ill. 80, 82 N. E. 615. An improvement may be local, though of some general benefit to the public, if it also specially benefits the property assessed. Loeffler v. City of Chicago, 246 Ill. 43, 92 N. E. 586, 20 Ann. Cas. 335. Constructing a reservoir, digging a well, erecting a standpipe and pumping works and building for the same, with a view of constructing water works in a city, when of general utility to its inhabitants, are regarded as a public improvement to be paid for by general taxation, Ewart v. Village of Western Springs, 180 Ill. 318, 54 N. E. 478; but where structures are not of general utility to all the inhabitants of the municipality, but are only used for the benefit of a small part thereof, they are to be regarded as a local improvement. Fisher v. City of Chicago, 213 Ill. 268, 72 N. E. 680.

WATER COMPANY HELD LIABLE TO PARTY INJURED UNDER INDIANA STATUTE FOR INJURY BY DEFECTIVE FIRE HYDRANT

The Indiana Supreme Court holds, Trustees of J. D. Mem. M. C. Church v. New Albany Water Works, 130 N. W. 827, that a water company which, after agreeing in its contract with the city to keep fire hydrants in repair and furnish sufficient water to put out fires, surrendered its franchise for an indeterminate permit, was liable to a church under the Indiana Public Service Act, pars. 7 and 116, for loss by fire occasioned by the defective condition of a hydrant which the company negligently failed to keep in proper order; the liability in favor of the party injured being created by the provision in the latter section that: "If any public utility . . . shall omit to do any act, matter or thing required to be done by this act such public service utility shall be liable to the person, firm, or corporation injured thereby in the amount of damages sustained in consequence of such violation."

STATE AND TOWNS HELD NOT NEGLIGENT IN FAILING TO ERECT BARRIERS ALONGSIDE HIGHWAY

The New York Court of Claims holds, Best v. State, 186 N. Y. Supp. 359, that the state was not liable, under section 176 of the Highway Law and the amendments thereto, for the failure to erect barriers on an embankment at the side of a perfectly straight roadway, 22 feet wide and substantially level with the lands adjoining on one side, the embankment measuring about 12 feet at the deepest point on the other side. The state was therefore not liable for the death of a passenger in an autobus when the steering gear of the bus broke and the bus was deflected by one of the wheels striking loose gravel placed by the state alongside the macadam road bed, resulting in its falling over the embankment. The court said that if this action had been against a town, the town, under the authorities, would not be liable, because the town or its commissioner could not reasonably be held to anticipate such an emergency; and the state could only be held liable where the same state of facts would make a town liable for defects in its highway.

There are many authorities in the state of New York which hold, where the conditions are similar to those in this case, and where an emergency occurred which caused an accident, that such condition was not a defect, and it was further held that it was not negligence on the part of its commissioners to fail to erect barriers at such places. It has recently been decided by the Appellate Division, Third Department, where the circumstances were the same as in this case, where the plaintiff was driving an automobile truck upon an improved macadam highway, smooth and level for 20 feet in width, and the automobile locked wheels with a passing buggy, and in doing so the automobile turned at right angles to the road and went head over the embankment, that the commissioner of highways was not negligent in failing to erect barriers at a location of this kind; and it was further held that he was under no duty to anticipate such an emergency. Dorrer v. Town of Callicoon, 183 App. Div. 186, 170 N. Y. Supp. 676.

PAVING OF RAILROAD CROSSING BY RAILROADS

The Minnesota Supreme Court holds, State ex rel. City of Fairmont v. Chicago, St. P., M. & O. Ry. Co., 180 N. W. 295, that when the public welfare, convenience or safety requires a city street crossing a railroad right of way to be paved, and the city council so determines, the city may in the exercise of its police power compel the railroad to pave the crossing at its own cost. It is not enough that a foundation for a roadway is furnished. The police power of the municipality goes to the extent of compelling the railroad to maintain a surface thereon suitable for convenient travel. Of course the police power with reference to this subject, as well as to others coming within its application, may not be exercised arbitrarily or oppressively.

NEWS OF THE SOCIETIES

June 20—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Salt Lake City.

June 20-24—AMERICAN INSTITUTE OF CHEMICAL ENGINEERS. 13th semi-annual meeting. Detroit, Mich.

June 20-24—AMERICAN SOCIETY FOR TESTING MATERIALS. Annual meeting. Asbury Park, N. J.

June 21-22—LEAGUE OF TEXAS MUNICIPALITIES. Annual Convention. Wichita Falls, Texas. Secy., Frank M. Stewart, University of Texas, Austin.

June 21-24—AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS. Joint annual and Pacific Coast convention. Salt Lake City, Utah.

June 28 — ATLANTA SECTION AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Election of officers. Georgia School of Technology, Atlanta.

June 28-July 1 — SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, UNIVERSITY OF PITTSBURG. Annual convention. New Haven, Conn.

July 15—NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Annual meeting. Crown Hotel, Providence, R. I.

Aug. 10-12—INTERNATIONAL ASSOCIATION OF STREET CLEANING OFFICIALS. Annual conference. Hotel La Salle, Chicago, Ill.

Aug. 23-25—AMERICAN ASSOCIATION OF PARK SUPERINTENDENTS. Annual meeting. Detroit, Mich. Secretary, Emmet P. Griffin, Superintendent of Park, East St. Louis, Ill.

Sept. 13-16—NEW ENGLAND WATER WORKS ASSOCIATION. 39th annual convention. Bridgeport, Conn. Secretary, Frank J. Gifford, 715 Treont Temple, Boston, Mass.

Sept. 28 (10 days)—NEW YORK ELECTRICAL EXPOSITION. Seventy-first Regiment Armory, New York City.

Oct. 11-14—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual Convention. Atlanta, Ga. Hotel Ansley. Secretary, James J. Mulcahey, Municipal Building, Denver, Colo.

Oct. 24-28—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Southern Hotel, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Oct. 31-Nov. 5—NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Power show in connection with INTERNATIONAL TEXTILE EXPOSITION. Mechanics' Building, Boston, Mass. Secretary, James F. Morgan, Devonshire st., Boston.

Nov. 14-18—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

CONFERENCE OF STATE SANITARY YENGINEERS

The Conference of State Sanitary Engineers, which was tentatively formed at New Orleans in 1919 and which met in Washington in 1920, perfected its organization by the adoption of a constitution at Boston recently. Officers were elected for the ensuing year. They are: chairman, C. A. Emerson, Jr.; vice-president, W. H. Dittoe; secretary-treasurer, Theodore Horton.

At this Boston meeting there was a very interesting program of committee reports and papers and active discussions on water supply, sewage disposal, mosquito control, and other lines of work conducted by the state and federal health departments. Noteworthy papers were "State Sanitation" by Prof. George C. Whipple of Harvard University, and "The Typhoid Epidemic at Salem, Ohio," by W. H. Dittoe.

THE NEW ENGLAND WATER WORKS ASSOCIATION

The June outing of the Association will be held at Wardhurst, Lake Suntaug, Lynnfield, Mass., Wednesday, June 22, 1921. Meeting of the Executive Committee and business meeting of the Association will be held during the day.

Dinner served at 1 o'clock. Trains leave Boston (North Station) 9:45; 10:25 and 11:00 A.M., Eastern Standard Time, for Lynn, Mass. Busses leave Lynn (Central Square) 10:30 and 11:35 A.M., Daylight Saving Time, for Lynnfield. Train leaves Boston for Lynnfield at 10:15 A.M., returning leave Lynnfield at 5:07, Eastern Standard Time. The 1921 Annual Convention of the Association will be held at Bridgeport, Conn., September 13 to 16, inc. Headquarters at Stratfield Hotel. Charles W. Sherman, president; Frank J. Gifford, secretary; Frank Emerson, Edward M. Shedd, Richard N. Ellis, committee June outing.

AMERICAN ASSOCIATION OF ENGINEERS

Counting and tabulating 25,000 letter ballots for candidates in the national election of officers of the American Association of Engineers would require a force of 20 men working 3 days in two shifts if done by hand. This work was accomplished by use of a letter ballot of special card type and a tabulating machine. As fast as the ballots were received they were taken out of the envelope by the tellers, counted as to number and sent to the punching machine, where a hole was punched in the ballot to indicate each man's choice. The ballot then passed through a verifying machine which did not punch any holes but in case the punching was wrong an electrical alarm was given. There are three independent checks on the accuracy of counting in this tabulating machine.

PERSONALS

True, Albert O., has been retained as resident engineer on the construction of a reservoir and filter plant for the town of Wauseon, Ohio.

Mylchreest, J. Warren, has been appointed city engineer of Middletown, Ohio.

Bright, J. S., formerly district engineer for the U. S. Bureau of Public Roads at Denver, Colorado, has been transferred to San Francisco.

Parke, R. W., has been appointed construction engineer for the new seventh district, North Carolina State Highway Commission, with headquarters at Elkin, N. C. S. C. Currier is now district engineer, and U. L. Fisher maintenance engineer for the same district.

McComb, Major D. Q., is now chief engineer of the Tennessee Highway Department.

Bechthold, W. A., formerly assistant county highway commissioner of Racine county, Wisconsin, has been appointed county highway commissioner of that county.

Braunworth, P. S., of Newark, N. J., has been appointed manager of the water plant of Garfield, N. J.

Dryden, F. H., has been appointed city engineer of Salisbury, Md.

Hutchins, M. C., has been reappointed city engineer of Charlotte, N. C.

Sachs, William, has been appointed borough engineer of West Hazleton, Pennsylvania.

Schneider, Delmont J., has been appointed city engineer and street commissioner of Pocatello, Idaho.

Harrington, W. H., engineer of the West Side Irrigation District, has been appointed city engineer of Tracy, California.

Belk, Claude E., has been appointed city manager and purchasing agent of Houston, Texas.

Stinchfield, M. J., Jr., of Valparaiso, Ind., has been appointed assistant state engineer.

Bibbins, James Rowland, has resigned as supervising engineer of the Arnold Co. to become manager of the Department of Commerce and Communication of the United States Chamber of Commerce at Washington, D. C.

Ingemanson, Thure W., has been appointed resident engineer on paving work at Nora Springs, Iowa.

Bailey, H. G., has been engaged as highway engineer of Henderson county, N. C.

Fik, John B., has been appointed city engineer of Muskegon, Mich.

Houston, G. N., formerly acting commissioner of irrigation in the reclamation branch, Department of the Interior, Canada, has accepted a position as head of the provincial irrigation work with the Alberta government.

McKee, J. B., has been appointed city engineer of Plattsmouth, Neb.

Shriver, Clarence E., formerly special engineer with the Tallassee Power Co., Badin, N. C., in connection with street layouts on sidewalk and drainage work, water filtration, sewage disposal plants and systems, is now with the Kentucky State Highway Department.

Schultz, Charles, has been appointed city engineer of McKinney, Texas.

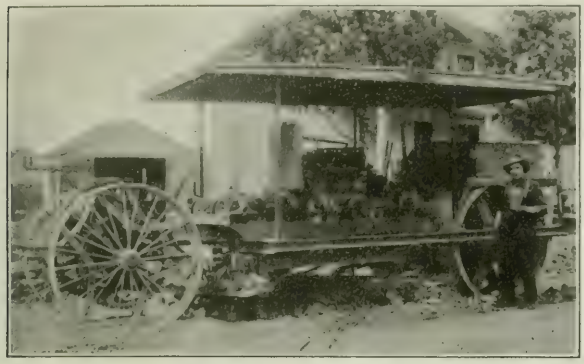
Dwyer, William J., has been appointed county superintendent of highways of Cortland county, N. Y.

Kurtz, John A., of Kansas City, Mo., has been reappointed member of the State Public Service Commission.

Rose, David, has resigned as county engineer of Koochicking county, Minnesota, to become district engineer of the State Highway Commission at Bemedji. His successor is A. B. Peterson, of Ericksburg.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations



TRIPLE ACTION ROAD BUILDER MACHINE MAKING NEW GRADE ON CLAY AND STONE ROAD

OSWALD ROAD BUILDER

The Oswald triple action road builder, manufactured by the American Road Machinery Co., is designed to scarify and pulverize the hardest kind of macadam. It is a powerful, 13-ton, 4-wheel drive machine operated by a Liberty continental governed 4-cylinder, 45 h. p. motor, making 4,000 R. P. M. and equipped with an impulse starter, centrifugal cooling pumps, oil forced feed and splash oil system, and has a hollow crank.

The reversible grading blade is 18 inches wide and can be made up to 12 feet in length. The cast steel scarifier cuts a swath 7 feet 5 inches long and has 18 teeth 19 inches long that are held in place without bolts and can be changed in 10 seconds.

The normal compression of 240 pounds per square inch on the rear rolls can be increased to 300 pounds by filling them with water. The scarifier and blade are operated by a mechanical oil pump. The machine is 22 feet long, 8 feet 3 inches wide and 9 feet high and has a wheel base of 16 feet. The machine is operated easily by one man and has covered 3 miles of badly rutted and worn macadam road, putting it in good shape in 8 hours with a consumption of 2 gallons of gasoline per hour. It has a forward speed of 2 miles or of 4 miles per hour and a reverse speed of 2 miles per hour.

SULLIVAN DRILL SHARPENER

Drill sharpeners for hammer forging drill bits and shanks are made by the Sullivan Machinery Co. and described in bulletin 72-E. They are built in two sizes and consist of a clamp or vise, an upsetting hammer and a swaging hammer mounted on one compact frame. Their use is advantageous on account of the facility with which the work is done so preventing loss of time to machine and operator, to the labor economy which enables one smith and helper to handle as much steel as several hand crews, and to the uniformity which insures perfection in shape of all bits and accuracy of their dimensions.

The gradual hammer action preserves the quality of the steel and increases the strength and toughness, while the low forging heat enables the highest carbon steel to be handled without danger of burning. New bits can be made from bar stock in one minute or less; ordinary dull bits can be resharpened at the rate of 100 to 140 per hour.

The machines are adaptable to a considerable variety of work such as forging hammer heads and small tools and making bolts. The vertical member of the class A sharpener forms a light forge hammer for general utility. Bits made by the Sullivan air hammer process cut faster and farther and loose their edge and gauge less rapidly than bits made and sharpened by other methods.

The temperatures required for proper handling of steel in this machine range from 1,500 to 1,750 degrees Fahrenheit. The Sullivan drill steel furnace has been designed especially to secure more uniform heat for the drills to be sharpened.

The drill sharpener is built around two hammers and a compressed air vise, occupies a floor area of 5x2½ feet and 6 feet high, and weighs 4,000 pounds. The vise is operated at a pressure of more than 100,000 pounds and the hammers are under perfect control, being able to strike a single blow or many blows in succession and either light or heavy increments at will. Shanks can be made in one heat when only swaging or upsetting are required and in two heats when both swaging and upsetting are necessary. When ordered, the machines are equipped with a small pneumatic punch to open the holes in the hollow steels.

All the working parts are easily accessible and dolleys and dies can be quickly changed. The machines are operated with compressed air at 80 to 100 pounds pressure and consume only a small quantity of it.

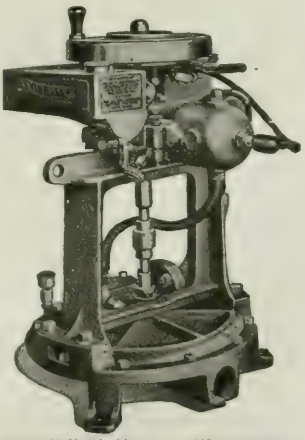
Light drill sharpeners, class B, are designed and built to fill the demand for machinery adapted for forge hammer drill bits and shanks. It occupies a 4x2½-foot floor space, is 5 feet high, and weighs 1,500 pounds. It is suitable for steels 1¼ inches in diameter or less, for 2½-inch bits.

EVINRUDE UNIT CENTRIFUGAL PUMPS

Unit centrifugal pumps made by the Evinrude Motor Co., consist of two main parts, the pump proper and the motor, which constitute a single unit complete in itself without gears, belts or chains.

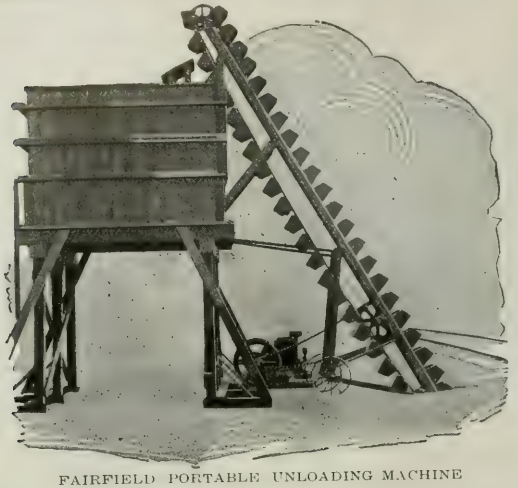
Ignition is furnished by the Evinrude magneto built into the fly wheel and insulated and protected so that it cannot be in anyway damaged or put out of commission by dampness, or even by a drenching rain. It is provided with an extra large strainer that prevents the clogging of circulation waters and has a universal joint connecting the drive shaft.

The floor space required is only 19½ x 19½ inches, and its weight is only 115 pounds. The parts are few, the construction is rugged and it can be easily operated by an intelligent boy. It is made in two sizes, of 2 H.P. and 3½ H.P., with capacities of 2,000 gallons lifted 35 feet per hour and 1500 gallons to 45 feet per hour respective-



EVINRUDE UNIT CENTRIFUGAL PUMP

ly. For a lift of only 5 feet the corresponding capacities are 6,700 and 8,800 gallons per hour. When practical it is advised to submerge the pump, thus obviating the necessity of a suction pipe or priming.



FAIRFIELD PORTABLE UNLOADING MACHINE

STERLING ENGINES FOR EMERGENCY PUMPING

High powered Sterling gasoline engines up to 300 h. p. can be furnished for $16 to $30 per h. p. and are strongly recommended as auxiliaries to steam and hydro-electric power plants to insure service during breakdowns or other emergencies. They are self-contained units, instantly ready when started to assume full load, are easily operated, occupy very little space, have a low maintenance cost, can operate at centrifugal pump or generator speed. Are made with 4, 6 or 8 cylinders, intended to operate at 800 to 1,500 r. p. m. They are described in a circular issued by the Sterling Engine Company, Buffalo, N. Y., which illustrates their application to a number of city water works plants, where single machines discharge up to 3,000,000 gallons daily, up to total heads of 125 pounds.

FAIRFIELD CAR UNLOADER

The Fairfield portable car unloader and storage bin, manufactured by the Fairfield Engineering Company, is adapted for unloading, storing and loading sand, gravel, crushed stone or coal. The regular equipment consists of an eight horsepower kerosene engine with roller chain attached to a bucket elevator, provided with a two-wheel steel truck and discharging into a 30-ton elevated hopper bottom wooden storage bin supported on trestles with clearance for an automobile truck to drive under and be loaded by gravity through two sliding plate valves. The elevator is supplied through a track feeder which consists of a steel transverse trough installed below the rails and delivering the dumped material to the foot of the elevator. The bin is of sectional construction and the whole equipment can be installed and removed under ordinary conditions for $50. With it one man can unload 30 to 40 tons of material in 1½ hours, taking the place of a large gang of men and saving $8 or $9 in labor on every 50-ton car unloaded, beside reducing the idle time of trucks in service distributing material from the bin.

WHEEL TYPE OF P & H EXCAVATOR

This machine, manufactured by the Pawling & Harnischfeger Co., and described in bulletin IX, was designed for use on rough roads, with a narrow width, so as to occupy only a portion of the right of way, to use convenient fuel accessible readily in isolated spots, and to be so well constructed as to avoid breaking and be able to maintain a high rate of speed when working under favorable conditions. It is interchangeable so as to run on either side of the street, can throw the spoil to one side leaving the other side clear for traffic and is operated economically.

The engine is mounted on a steel truck with caterpillar traction in front under the foot of the vertical frame having an adjustable double boom containing the digging wheel and raising or lowering it into the ditch as required.

The trench is excavated full width and depth at a single progressive operation by buckets on the periphery of the digging wheel that automatically discharge into a transverse steel slot conveyor, depositing the soil alongside the trench. The selective transmission permits three instantaneous changes by a gear shifting lever, besides the changes obtainable by changing sprockets. Between February 1 and October 5, 1917, one of the machines excavated 4 miles of 6 and 12-inch water main trenches in wooded or frozen ground with shale at the bottom, for the water department of Erie, Pa. In gravel, which required sheeting, 1,620 feet of trench were excavated for a labor and fuel cost of 8.2 cents per foot as compared with a cost of 36.08 cents for hand work and backfilling.

Another machine excavated a daily average of 832 linear feet of telephone trench at a cost of $68.03, including fixed and overhead expenses, where it was estimated that hand labor for the same work would have cost from 25 to 30 cents per linear foot on the same wage scale.

AIR PUMPING

Air pumps manufactured by the Harris Air Pump Co., are specially designed and arranged for high efficiency, have no valves or moving parts, have smooth, unobstructed entrance and discharge openings combined with patented venturi mixing chamber, are compactly constructed of jointless bronze and are provided with specially designed arrangements to allow scale and dirt to pass out of the air line.

The booster pump operates automatically to deliver or elevate a fluid any required distance without additional air. Pumps have low operating and maintenance cost and have an unlimited height of lift, the pump has two cylinders side by side, provided with an automatic switch which allows the water to enter one cylinder by gravity while it is expelled from the other by air pressure, then reverses the process and so on. An single valve in the discharge line governs the quantity of discharge. The pumps are recommended for municipalities, for contractors and for use in driven wells and may be adopted to deep wells if necessary submergence is not obtained and specially designed tanks are used in the wells.

WANTED—Contractor or Builder to form partnership or association on some profitable work. Address Responsible, care Public Works.

INDUSTRIAL NOTES

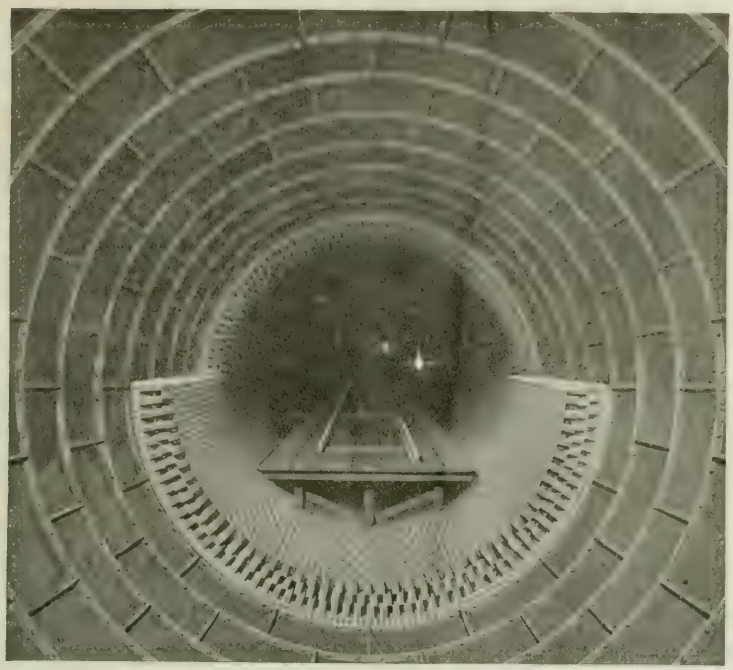
The purchase of the Aetna Explosives Company's properties, assets and business by the Hercules Powder Company has been sanctioned by the Aetna stockholders. By this purchase the Hercules Company will acquire high explosives, or dynamite, plants near Birmingham, Ala., Emporium, Pa., Sinnamahoning, Pa., Ishpeming, Mich., and Fayville, Ill., two black blasting powder plants, one at Goes Station, Ohio, and the other near Birmingham, Ala., a plant for the manufacture of blasting caps and electric blasting caps at Port Ewen, N. Y., and a plant for the manufacture of fulminate of mercury, for use in blasting caps, at Prescott, Ontario, Canada.

With the Aetna Company's business, the Hercules Powder Company becomes a much larger factor in the explosive business of the United States, is now in a position to compete for business in all parts of the United States, and will be greatly strengthened in important fields which have hitherto been closed to it on account of freight rates.

HELTZEL PLANT PRODUCTION UNINTERRUPTED BY FIRE

The plant of the Heltzel Steel Form & Iron Company, Warren, Ohio, was partly destroyed by fire on Thursday, June 2.

The steel fabricating department suffered mostly from the damage—shipments of steel forms having been made a short time after the fire. This department has continued operation almost uninterruptedly since the fire.



Truscon Tunnel Liner Plates, Seven-Mile Road and Gratiot Ave. Sewers, Detroit, Michigan.
Outside diameter of sewers, 12 ft. to 13 ft. 8 in.

Truscon Tunnel Liner Plates

The modern method of tunneling under ground is to use pressed steel liner plates to support the earth. These liner plates consist of flanged sections which are bolted together, making a continuous rigid shell which can be carried forward a considerable distance in advance of the masonry. They are equally satisfactory if used with brick or concrete. Removable steel forms can be used for the inner face of the tunnel.

Safety to the workers is assured by providing this rigid steel lining. Convenience and economy, together with saving in shoring, result from the small-sized sections and the rigid continuity secured by bolting these sections together. The entire construction is speeded because of the simplicity in using plates and the fact that the tunnelers can keep in advance of the construction forces.

The Truscon Steel Co. has unusual facilities for making Steel Tunnel Liner Plates, as well as a wide variety of steel forms. Our equipment of presses is large and our shops for die-making unexcelled. When figuring your next sewer job get in touch with us and let us quote you prices on Truscon Forms and Truscon Liner Plates.

◆ TRUSCON ◆
PRESSED STEEL

Truscon Steel Company
Youngstown, Ohio
Warehouses and Sales Offices in Principal Cities

Heltzel Steel Road Forms

"Facts, not Sales Arguments, prove an article worthy of your serious consideration."

It's a fact—G. H. Katterjohn & Son, Contractors, Paducah, Kentucky, will use this year the *same* HELTZEL STEEL FORMS purchased 13 years ago.

That's why we say HELTZEL STEEL FORMS are Durable, Practical and Dependable.

Further, by using HELTZEL STEEL FORMS you are assured of a minimum repair expense bill at the end of the season.

"Simply made—Simply laid."

The Heltzel Steel Form and Iron Company

WARREN - - - OHIO

AMERICAN BRIDGE COMPANY

HUDSON TERMINAL-30 CHURCH STREET, NEW YORK

Manufacturers of Steel Structures of all classes particularly BRIDGES AND BUILDINGS

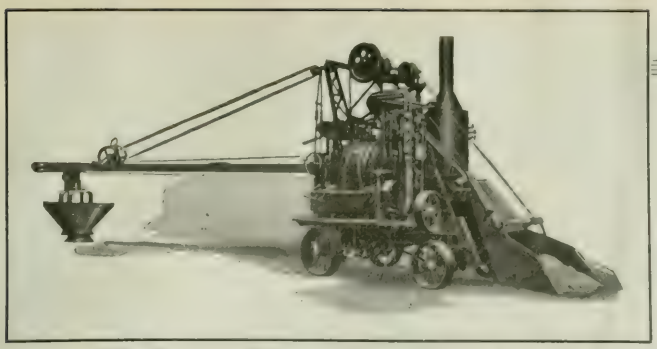
Sales Offices

NEW YORK, N. Y.	30 Church Street
Philadelphia, Pa.	Widener Building
Boston, Mass.	John Hancock Building
Baltimore, Md.	Continental Trust Building
PITTSBURGH, PA.	Frick Building
Buffalo, N. Y.	Marine National Bank
Cincinnati, Ohio	Union Trust Building
Atlanta, Ga.	Candler Building
Cleveland, Ohio	Guardian Building
Detroit, Mich.	Beecher Ave. & M. C. R. R.
CHICAGO, ILL.	208 South La Salle Street
St. Louis, Mo.	Third National Bank Building
Denver, Colo.	First National Bank Building
Salt Lake City, Utah	Walker Bank Building
Duluth, Minn.	Wolvin Building
Minneapolis, Minn.	7th Ave. & 2nd St., S. E.

Pacific Coast Representative:
U. S. Steel Products Co., Pacific Coast Dept.:

San Francisco, Cal.	Rialto Building
Portland, Ore.	Selling Building
Seattle, Wash.	4th Ave. So., Cor. Conn. St.

Export Representative: United States Steel Products Co., 30 Church St., N. Y.



A Mixer *for the* Road Contractor

"The Standard" Special Street Paving Mixer

A medium sized machine, at a real low price, well adapted to the average road job. It has a capacity of 14 cubic feet of unmixed or 10 cubic feet of mixer material per batch.

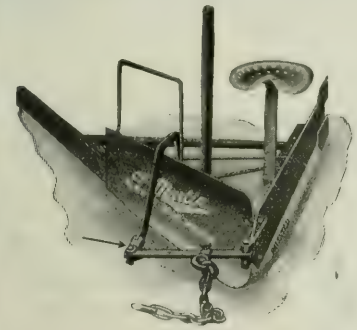
THE UTMOST VALUE FOR YOUR INVESTMENT

It reduces the time, effort and expense involved in every operation that enters into the mixing of concrete. Especially adapted for all kinds of road and street work, including the laying of sidewalks, curbs and gutters.

Catalog will be sent upon request.
Ask for catalog No. 63

The Standard Scale & Supply Co.

PITTSBURGH, 1631 Liberty Ave.
NEW YORK, 145 Chambers St. CHICAGO, 163-171 N. May St.
PHILADELPHIA, 523 Arch St. CLEVELAND, 1547 Columbus Rd.
BALTIMORE, 409 N. Gay St.



"Cutting a Road Through the Fields"

Make the Whole Road From Ditch to Crown As You Go

With THE Martin O.D.&G.CO. REGISTERED

PERFECT ROAD MAKER

Cleans out side ditches, fills ruts and low places, and grades dirt to center of road at the same operation. Leaves the road about as smooth and hard as an oak floor. A few trips each way—often one—makes the road complete from ditch to crown. Eliminates half the labor of road grading. Cuts costs right in two. Operates with horses or tractor. 5 or 7 ft. blades with 8 ft. steel plated extension. Adjustable for narrow or wide roads. Write for printed matter.

Sold on 10 days' trial

Owensboro Ditcher & Grader Co., Inc.

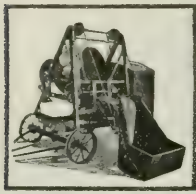
Box 700 Owensboro, Ky.

COLD PATCH

Maintenance Our Specialty
HEADLEY GOOD ROADS CO.
Franklin Trust Building
Philadelphia, Pa.

ASPHALT AND ROAD OIL

ASPHALT PAVING PLANTS ALL KINDS
PORTABLE DRYERS
PORTABLE KETTLES
FIRE WAGONS, ETC.
THE HETHERINGTON PLANTS
HETHERINGTON & BERNER
INDIANAPOLIS, INDIANA, U. S. A.



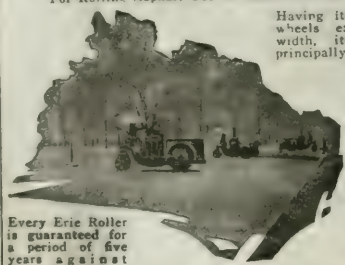
JAEGER MIXERS—A MIX A MINUTE
FOURTEEN DIFFERENT OUTFITS THREE DIFFERENT SIZES
The Jaeger line of mixers offers the most complete high grade line ever offered under one name.
THE JAEGER MACHINE CO., 400 DUBLIN AVE., COLUMBUS, OHIO

ETNYRE
MOTOR DRIVEN STREET FLUSHERS
are reliable and efficient, and reduce the cost of street cleaning to the minimum.
We furnish complete Motor Truck Flushers, Sprinklers or Oilers in any desired capacity, or Units only for mounting on any make of chassis.
Write for detailed information
E. D. ETNYRE & COMPANY
OREGON, ILLINOIS
Manufacturers of Horse Drawn and Motor Driven Flushers, Sprinklers and Oilers

The Wyckoff Pipe & Creosoting Co., Inc.
GENERAL CREOSOTERS—ESTABLISHED 1831
Creosoted Wood Block, Conduit, Cross-Arms, Anchor Blocks, Poles, Cross-Ties, Piling, Wharf Timbers, Bridge Timbers, Lumber, etc., Water Pipe, Steam Pipe Casings, Liquor Log.
Main Office: 17 East 42nd St., New York, N.Y.
Factory: Portsmouth, Virginia

Hard Top Highways—Armor Plate Roads
WILLITE
TRADE MARK REG. U.S. PAT. OFF.
The Best Surface For Long Service
Willite Road Construction Co. of America
51 Chambers St., New York City

For Rolling Asphalt Use an Erie Tandem Paving Roller.



Having its front and rear wheels exactly the same width, its weight placed principally on the large roll and its steering wheel divided with sections, this roller will prove a money-maker for any contractor who constructs asphalt or brick pavements or low crowned macadam roads. Write for catalog.
Every Erie Roller is guaranteed for a period of five years against faulty material or imperfect workmanship of any kind.
ERIE MACHINE SHOPS
ERIE PENNSYLVANIA

SAVE TIME AND LABOR
By purchasing the Dependable
O. S. Locomotive Crane
for handling your material. We equip them with various automatic devices for the economical handling of material.
Write for details.
Orton & Steinbrenner Co.
Chicago, Ill.
Factory: Huntington, Ind.

POWER-STRUCTURE
TRADE
GIANT
MARK
-PRODUCTION-

Keep Your Equipment Up to Date

A "man with the hoe" was the original concrete mixer.

You wouldn't think of using such methods now; modern, efficient methods are necessary if your business is to show a profit.

Giant Mixers represent the last word in concrete mixing machinery. They put efficiency in your work and dollars in your pocket.

There are no useless attachments on Giant Mixers to add complications without increasing the output. Giant Mixers are made to mix concrete, quickly and economically.

Send today for the Giant catalog. You will find a mixer that exactly suits your needs in the Giant line, and at a price that will save you money.

JUDY MANUFACTURING CO.

Box 689-A Centerville, Iowa

Distributors:

Eastern Equipment & Service Co., 1001 Chestnut St., Philadelphia, Pa. 25 Church St., New York City

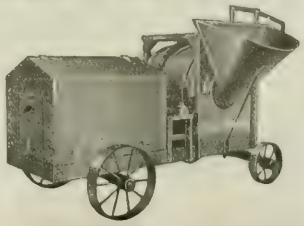
Chartrand-Peters Co., 508 Mutual Bldg., Kansas City, Mo.

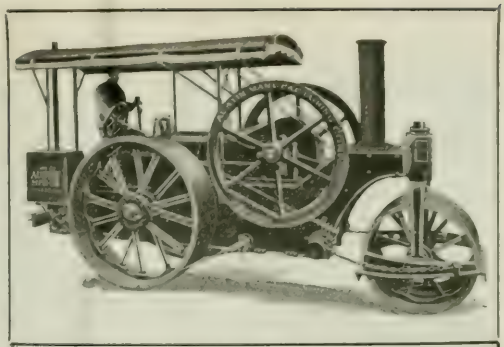
St. Louis Bridge & Supply Co., Frisco Bldg., St. Louis, Mo.

The Clarence L. Boyd Co., Guthrie, Okla.

Fairbanks-Morse & Co., Denver, Colo.

Service Stations throughout the New England and Middle Atlantic States. Main distributing warehouse at Philadelphia.





AUSTIN MOTOR ROLLER

100% DIVIDENDS

In Service and Satisfaction

AUSTIN ROLLERS haven't joined the ranks of the investments that pass dividends in hard times, and they never will.

On the job every minute and staying there for years, they are a sure source of constant satisfaction and profit to contractor or public official.

An Austin Roller is better than the best bond on earth as a guarantee that your work will be done on time and done right.

Three-wheeled Rollers in two types—Motor and Steam—with or without Scarifier Attachment—and in five sizes. Satisfy all requirements and suit all tastes.

Four sizes of Tandem Rollers, but only the Motor type which has proved to be in a class by itself.

Your copy of the New Austin Roller Catalog, just off the press, will be on its way within an hour of the time your request reaches us.

It's worth asking for.

The Austin-Western Road Machinery Co.

CHICAGO

Albany
Atlanta
Billings
Columbus
Dallas
Boston
Denver
Jackson
Los Angeles
Nashville
New Orleans
New York
Oklahoma City
Philadelphia
Pittsburgh
Portland
Richmond
St. Paul
San Francisco
Salt Lake City
Ponca
Wahoo

EXPORT DEPARTMENT
ALMACOA ALLIED MACHINERY COMPANY OF AMERICA ALMACOA

Fleet of Trucks, All Equipped with Standard Steel Dump Bodies, Used by J. E. Kathyrn & Co., Kansas City, Mo., for Road Work in Jackson County, Missouri

J. E. Kathyrn & Company Recommends Standard Bodies

J. E. Kathyrn and Company, Kansas City, Mo., are among the many large contracting firms that are demonstrating the unequaled performance, durability and economy of Standard Steel Dump Bodies on road work and other types of construction.

"The operation of Standard Steel Dump Bodies is satisfactory in every respect," says Mr. J. E. Kathyrn, president. "In road work, as well as other work, Standard Bodies stand up and are always ready to do a day's work. This is what makes heavy hauling more profitable."

We have a *complete* line of Standard Steel Dump Bodies ready to ship, and also make bodies to specifications for special uses. Send name and address—a card will do—for the new Standard Catalogue and price lists.

STANDARD STEEL WORKS

1732 Tracy Avenue **Kansas City, Mo.**

Standard Steel Dump Bodies

PUBLIC WORKS.

CITY **COUNTY** **STATE**

A Combination of "MUNICIPAL JOURNAL" and "CONTRACTING"
Published Weekly by Municipal Journal and Engineer, Inc.

Publication Office, Floral Park, N. Y. Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.
Entered as Second-Class matter at the Post Office at Floral Park, N. Y., August 27, 1920, under the Act of March 3, 1879

Vol. 50 **JUNE 25, 1921** **No. 26**

Concrete Bridge Construction*

Standard and special methods, operations and plants for building substructure and superstructure of slab, girder, and arch spans, for highway and railroad traffic. The storing and handling of aggregate and cement; mixing, conveying, and placing concrete; construction of forms and falsework; striking arch centers; finishing concrete surfaces; making, transporting, and assembling pre-cast members; erecting, shifting and adjusting steel truss centers

Up to a maximum of about 30 feet for railroad service, and 40 or 50 feet for highway service, concrete bridges may be made with flat slabs or reinforced concrete girders, but above those spans they must either be hinged or hingeless arches, and may have full barrel vaults or multiple ribs. All arch spans either have solid longitudinal, spandril walls retaining a solid fill over the haunches up to the level of the crown or else they have a solid reinforced concrete floor slab supported on concrete girders carried by spandril posts, or by spandril arches.

The construction of concrete arch spans is divisible into five different operations, that of the substructure, the arch, or ribs, the spandril work, the floor and parapet or handrail. The necessity for very satisfactory and reliable foundations is so great that arches are not generally selected in cases where it is foreseen that great difficulties will be encountered in the foundations.

SUBSTRUCTURE

Ordinarily the foundations should be carried to rock or very satisfactory hard stratum; should not be exposed to scour, disturbance by adjacent subsequent operations, and the footing should be proportioned for moderate loads on prepared surfaces that should be inspected and concreted in the dry. They are made with the usual methods for mass concrete in open dry land pits, but where they are made in quicksand in very wet soil or in the river bed they generally require to be built in cofferdams or, under extreme conditions, by pneumatic caisson method. They sometimes have pile footings, but these are undesirable if they can be avoided.

Generally these piers are built with mass concrete without reinforcement, but sometimes the abutments and the wing walls connected with them are reinforced or have reinforced extended footings. Usually the piers and abutments are built up several feet above the spring line and the ends of the arch spans are made integral with the substructure mass so that the curved portions overhang the vertical or battered faces of the piers, forming "umbrella" tops in which reinforcement bars are generally imbedded to bond with the arch ribs, so the construction joint thus becomes a sort of false skewback, the real skewback joint being provided at the theoretical intersection of the arch with the pier.

The construction of the cofferdams, unwatering them and bracing them are important features that are considered in another lecture.

CONCRETE MIXING AND HANDLING

Concrete for the piers and their footings should conform to standard requirements for ordinary mass concrete. The storing, mixing, conveying and distributing plants should generally be so designed and arranged as to be equally convenient and efficient for handling the concrete of the superstructure, including all of the five subdivisions of the bridge. A sufficient storage for aggregate and cement should be provided to last for several days and cover any possible interruption of delivery and as much as possible the aggregate should be handled by gravity alone from the time it is unloaded to the time it emerges from the mixer.

This can sometimes be accomplished by delivery of materials at road level or above, or by the installation of equipment on a side hill which may locate the concrete mixer below the level if requiring hoisting, which may thus be all concentrated at one point. Sometimes the materials can be unloaded from dump cars, but often it is necessary to provide clam-shell buckets or equivalent means of unloading them and sometimes conveying systems to distribute to the bins. For large jobs the concrete can be more advantageously mixed in two or more small mixers than in one

*Abstract of lecture illustrated by 50 stereopticon slides of methods, equipment and details delivered to the Junior and Senior classes in Civil Engineering at Cornell University, May 23, by Frank W. Skinner, consulting engineer, associate editor, PUBLIC WORKS.

very large one, an economy being thus effected and opportunity being provided for repairs and reduced service.

The mixer discharges directly into buckets, dump cars or loading hoppers serving the former. Under specially favorable circumstances the concrete may be spouted from the loading hopper directly to position for parts of the substructure, but generally it will have to be delivered to buckets handled by derricks or cableways or on flat cars on service tracks paralleling the bridge axis, or may be delivered directly to dump cars on the same tracks, which can discharge directly through chutes into the pier forms or in some circumstances into the forms for the superstructure.

If buckets are used they must be handled by derricks or cableways or by a locomotive crane also traveling on the service track. For one or two short spans under favorable conditions the entire work may consist of excavating for foundations, building forms, receiving, storing, mixing aggregate and putting it in place, and it may be handled by one or two stationary derricks, which, under some circumstances, are probably a more advantageous kind of plant.

CONCRETING IN LONGITUDINAL HALVES

Sometimes a long existing bridge is replaced by a series of concrete arch spans adjacent to and parallel with it, or occupying the same site, in which case it is frequently customary to build the new bridge of ample width and to construct it in successive longitudinal halves, the first one being built adjacent to the old one while the latter is in service, after which the traffic is transferred to the half of the new structure, the old structure removed and the new structure completed in its place. This system also provides for the whole or partial use of the old span for the building of the first half of the new span and the latter for building the second half. Frequently if the traffic is heavy it is impossible to install or operate complete facilities for material handling equipment entirely outside the limit of the new bridge and some of the construction plant is located on or over the bridge itself.

SLAB AND GIRDER SPANS

When short span superstructures consist simply of floor slabs or are a combination of concrete slabs and reinforced concrete girders, they may be built integral with the substructure and concreted in forms built at the site or, as is frequently the case, especially in railroad work and in the elimination of grade crossings where there are a large number of duplicate spans to be built, the floor slabs or the slabs and girders are pre-cast in the contractor's remote yard, and erected on the finished substructure.

Where there are a large number of short spans in one location, as in long viaducts, and in cases where there is very little clearance for heavy traffic that must be maintained, as in new city and town bridges provided for the elimination of grade crossings, economy or rapidity or safety is sometimes promoted by making the structure wholly or partly of pre-cast units which generally include the floor platform and sometimes the substructure. In the latter case piers are replaced by vertical or inclined posts or transverse bents made monolithic or in separate pieces joined with field connections, usually some type of mortise and tennon or doweled joint, and generally grouted. They are also usually provided with knee braces, cast integral with the vertical members.

Pre-cast bridge members are almost always concreted in simple forms on a horizontal plane, which are often arranged so that the forms can be stripped from the sides and used over and over again while the members themselves remain to season undisturbed on their own original supports until they are strong enough to be handled. Such members and especially floor slabs and straight beams and girders are likely to be built in two or more tiers, separated by heavy building paper or its equivalent, thus elimininating bottom pieces to the successive forms, and requiring only vertical extensions on their sides to receive new sets of members.

As it is impossible to handle the members without producing temporary stresses different from those in the structure in service great care is taken to provide complete rules and regulations for handling them, and usually attachments are provided to insure the hoisting tackle's being attached at the proper points and if necessary special reinforcement bars are put in to provide against temporary bending stresses that might produce tensions in members otherwise exposed only to compression.

The weight and dimensions of the cast iron members vary greatly from light struts or transverse bents perhaps only 10 or 15 feet long to girders or thick slabs that may weigh up to 60 tons or even more.

The most numerous kinds of pre-cast units are plain, flat, floor slabs that may be of uniform thickness of 10 to 20 inches and lengths of 10 to 30 feet. They are generally made in several longitudinal sections, together forming the full width of the floor with special sections under the rails and to form the parapets and curbs enclosing the track ballast. Such members are very simple and easily cast, weigh from 10 to 60 tons, and are generally handled on flat cars from which they are unloaded at the casting yards and at the site by some type of derrick car, gallows frame, gantry, or their equivalent. They may, however, be handled by one or more derrick booms or travelers similar to those used for steel bridge erection, sometimes with an overhang reaching in advance, which are convenient for building transverse bents of the substructure.

As the different members of the substructure and superstructure only require to be held in position until the joints are made and grouted, the erection may be very rapid and the structure quickly completed and opened to traffic, thus causing a minimum of obstruction or delay and avoiding the difficulties of form work, obstruction and long waiting for concrete cast in place.

CONCRETING AND ERECTING PRE-CAST FLOOR SLAB SPANS

In recent work of the Chicago & Northwestern Railroad Company, the substructures for short spans at street crossings have been concreted in

place and the superstructures have consisted of thick reinforced floor slabs pre-cast at the central material yard in Chicago and transported, sometimes a considerable distance, to the bridge site.

At the yard there are eight 8 x 30-foot adjustable concrete casting decks on timber platforms that can be leveled to compensate for settlement under the heavy loads. A single slab was cast on each deck, and after it was two weeks old was lifted by a derrick and set aside to cure six weeks longer before transporting to the bridge site. The slabs were generally handled by 150-ton wrecking cranes, which loaded and unloaded them to and from the standard flat cars on which they were transported.

The two-track American Avenue bridge, at Carrollville, Wis., has a 24-foot span, made with slabs 28 feet long that weigh 36 tons each. The pair of slabs for the first track were brought in on a service trestle alongside, and after they were set in position the track was shifted to them, the trestle removed, and the other slabs brought in on the new track and placed alongside, completing the bridge.

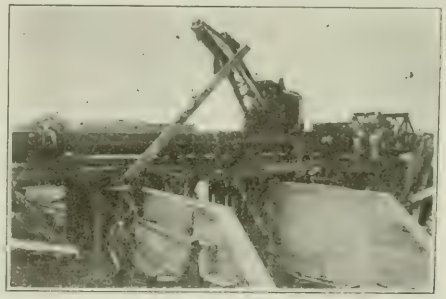
The slabs for the 28-foot three-track span at Litts avenue, Chicago, were 35 feet long, weighed from 53 to 60 tons each, and were handled by two 150-ton wrecking cranes, because the booms of the latter were not long enough for a single machine to do the work. The advantage of using pre-cast slabs was shown by the fact that only 40 minutes were required to place the six slabs required for the structure, remove the falsework and restore the railroad track on the bridge, ready for traffic.

ARCH BARRELS AND RIBS

Arch spans are almost invariably cast in place in simple forms in which the bottom part is virtually composed of the transverse horizontal lagging conforming to the curve of the finished intrados. The lagging is generally supported on multiple ribs in longitudinal planes. For short spans, concreted on wooden falsework, the ribs, or at least their upper parts, are formed generally by scarf boards consisting of two or three thicknesses of planks with their outer edges cut to the required curve and their lower edges straight forming chords of the arc. The members may be supported directly on beams, columns or struts or they may form the top chords of the trusses, usually of full spans with their bottom chords supported at the spring line at the ends and perhaps at intermediate points also on pile or trestle bents or on crib work. Such supports are used chiefly for moderate length spans and occasionally for longer spans where there is only one to be erected at the site.

When there is no objection to obstructing the ground, ordinary falsework is likely to be convenient and economical, but if the span is very high, or navigation must be maintained under it or if the bottom is bad, or the water very swift, the centering is generally supported on the permanent substructure itself, or on special falsework at the ends of the spans or sometimes on bents, or cribs, at points subdividing it. In any event, the direct support for the arch, which is called the centering, must always be made entirely separate from the falsework or equivalent substructure so that it may be easily lowered to clear it from the arch after the latter has become strong enough to be self-supporting. This operation is called "striking the center," and is usually accomplished by means of wedges, sand boxes, or sometimes jacks or special methods. In the great Walnut Lane span, Fairmont Park, the heavy, high falsework timber was kept saturated with water during the concreting of the arch ring and when that was completed was allowed to dry out while the concrete was curing, thus gradually shrinking away and automatically striking the center.

ERECTING 8-TON FLOOR SLABS WITH 150-TON WRECKING CRANES AT LITTS ST., CHICAGO



REMOVING FALSEWORK PREPARATORY TO ERECTING 36-TON PRECAST FLOOR SLABS ON SUBSTRUCTURE OF CARROLLVILLE BRIDGE

(To Be Continued)

ERECTING 36-TON FLOOR SLAB 24 FEET LONG

Designing Improvements in Toledo Sewers*

Calculating volume of storm water. Storm water regulators for connection with intercepting sewers. The sewage pumping plant, screens and outfall sewer.

Storm Water Allowances.—A study of the rainfall records at Toledo showed that rain falls approximately 600 hours during the year, but that for only 200 hours of this time does the rate of precipitation exceed .02 inch per hour. Because of the large flow in the Maumee river and its consequent large diluting factor, no provision has been made in the intercepting sewers for storm water run-off from combined districts with outfalls discharging into that stream. In the case of combined sewers discharging into the two creeks, provision has been made in the intercepting sewers for carrying, in addition to the future maximum dry-weather flow, run-off from precipitations that do not exceed .02 inches of rainfall per hour. This, it is believed, will permit the intercepting sewers to receive all of the first flow of the sewer which is polluted with sewage solids which had previously been deposited in the sewer inverts. In providing for this amount of storm water run-off it is assumed that the run-off from residential areas is 30 per cent of the rainfall and from densely built up areas is 70 per cent. It is proposed, as previously stated, that future sewerage shall be on the separate system and that only 30 per cent of the total drainage area will be served by sewers on the combined plan, and therefore provision for this run-off was made for only this percentage of the total area.

STORM WATER REGULATORS

Plans were prepared for storm water regulators or regulating devices to divert from the intercepting sewers all storm flow in excess of the estimated dry-weather flow plus the storm water run-off due to a precipitation of .02 inch per hour on the drainage areas served by combined sewers.

Adjustment may be made so that when storms take place at times other than those of maximum dry-weather flow during the earlier years of operation, it will not be necessary to take more than the estimated dry-weather flow plus the storm water allowance. Under the most extreme conditions, the storm sewage will carry dry-weather sewage pollution into the river not more than 600 hours a year and into the creeks not more than 200 hours. The regulating devices were designed so as to control the flow into the intercepting sewer not only in time of storm but also should the outlets of the existing combined sewers be partly or wholly submerged due to backwater from the streams at times of freshets, ice gorges and the like.

Two types of mechanical regulating devices were designed, a flap gate type for small flows and a revolving or swing type for large flows. The regulating chambers consist of three distinct compartments—a weir compartment, a gate compartment and a float compartment. The first replaces the existing sewer and contains a diverting weir, the crest of which is at the elevations to which the future maximum flow to be diverted will rise. The gate compartment contains the mechanical equipment and is connected with the weir compartment through a cast iron orifice. The float compartment contains the float for operating the gate and is connected with the weir compartment by means of a 4-inch cast iron pipe.

The flap gate type is a modification of the Gibbey foundry type. The revolving or swinging type gate has a face formed to an arc of a circle and revolves about a shaft which extends through the wall between the gate and float compartment. Under normal conditions the weight of the float holds the gate open and the weir diverts the flow from the combined sewer through the orifice and channel in the gate compartment to the intercepting sewer. If the level of the sewage rises because of storm water or of backwater from the stream, the float rises and causes the gate to cover a part of the orifice. The orifice is rectangular in shape and so placed that if the head increases 0.1 of a foot the area of opening is decreased so much that even with the increased head the quantity passing through is less than when the gate was completely open and the level of the sewage was at the weir crest. If the sewage continues to rise, the gate completely closes the opening and no discharge to the intercepting sewer takes place. Adjustment of the gate opening can be made as well as of the point where it will start to close.

SEWAGE PUMPING PLANT

The intercepting sewers on the west side of the river converge at a point a few feet west of the river at a point opposite an island, which is separated from the main land by a channel about 70 feet wide at this point. From the point of convergence a connecting sewer 90 inches in diameter and about 230 feet long extends under the channel to a pumping station on the island.

Here the sewage passes through openings provided with stop planks and thence through cage screens to suction wells. Five pumps, with provision for a sixth at a later date, are to be installed which will lift the sewage through a distance ordinarily of about 17 feet, which may be increased or decreased according to the level of water in the lake, with 2 to 12 additional friction head. The pumps force the sewage through a rectangular discharge sewer 6 feet by 7½ feet, which rises to and is placed just under the finished surface of the ground, its invert being about 2 feet below mean lake level. This discharge

*Continued from page 522

sewer, about 350 feet long, terminates in a skimming tank, where provision is made for skimming the matters floating in the sewage into a peripheral gutter. From the bottom of the skimming tank an outfall sewer is to be built consisting of a 60-inch reinforced concrete pipe extending about 575 feet from the skimming tank, where it ends in two branches extending at right angles up and down the river and just inside the boat channel line, through which branches the sewage will be discharged both at the ends and through eight nozzles.

Any excess flow of sewage which cannot be discharged through the 60-inch outfall above described will pass over a weir at the top of the skimming tank and flow through another 60-inch pipe which is continued for a short distance from shore, where it discharges through a single outlet. At some future time, if necessary, this pipe line may be extended to deep water and provided with multiple outlets.

Either or both of the two 60-inch outfall lines may be extended, if required, to future disposal works on the other side of the river. In such case the branches leading to the multiple outlets will be blocked off.

Just outside the pumping station the discharge sewer is provided with a spur to permit connection to chambers for fine screens, should fine screening or other treatment be found necessary in the future.

At the site of the pumping station four borings were made to a depth of about 32 feet below mean lake level. One on the main land disclosed about 12 feet of yellow clay top soil, underlain with blue clay. The three on the island passed through from 4 to 8 feet of muck and about half this depth of gravel, under which was hard blue or red clay. All of the foundations and structures rest on this hard clay except the discharge sewer, which will rest upon piles.

In order to afford access from the main land to the island, a concrete arch bridge is to be built spanning the channel at its narrowest point, where the width is about 60 feet.

The pumping station is 116 feet by 39 feet, with a screen wing at the center of the west side and a transformer wing at the center of the east. The superstructure is to be of brick masonry with stone trimmings and a tar and gravel roof. The sub-structure of the pumping station will extend to a depth of from 20 to 40 feet. The superstructure will be about 31 feet high and that of the wings about 23 feet high. The skimming tank will be about 20 by 30 feet, with a substructure 25 feet deep and a superstructure 20 feet high.

Just outside the screen room wall is a stop plank chamber. Three openings connect this with the screen chamber, controlled by three 4 feet by 5 feet sluice gates, which are operated by hydraulic cylinders. In the screen chamber are three diverging channels, in each of which are provisions for two cage screens, one behind the other, in order that one may be in use while the other is being cleaned. Each of these screen channels leads to the suction to two of the six pumps.

Each screen consists of a cage or box consisting of a frame built up of structural steel shapes, in which the screen bars are set. These bars are of half-inch galvanized iron pipe set around the front and two ends of the box. In the front they are in a double row, the pipes being staggered and spaced 2 ¼ inches apart between centers in each row, the two rows being 2 inches apart between centers. In each end there is a single row of bars spaced 1⅞ inches to 2¼ inches centers. The screen is 8 feet wide on the face, the ends are 28 inches deep, and the screen is 9 feet high. The screen is guided by T bar guides fastened to steel channels which are built in the concrete wall. The screens are elevated by hoists, each hoist consisting of a drum and motor, each screen being counter-weighted. Ordinarily the lift of the screen will be about 35 feet and the hoist is to be able to lift the screen this distance in a minute and a half.

Just beyond each pair of screens is a suction wall containing the lower ends of the suction pipes of two pumps. The pumps rest on a floor 15½ feet above the bottom of the bell-shaped opening of the suction pipe. Each pump discharges through a venturi meter, from which the sewage enters discharge channels of concrete which gradually converge from 6 to 3, these 3 combining into one just outside the building, where the discharge sewer begins.

The pumping plant consists of six pumps, five of which are to be installed at present. One of these has a capacity of 24 million gallons per 24 hours, and each of the other four has a capacity of 36 million gallons, at normal speed and with a 28-foot total lift, of which 15 feet is suction and 13 feet discharge. Each of these pumps has 36-inch suction and discharge pipes and contains a 36-inch by 24-inch venturi meter. Three of the pumps are constant speed and two of them, including the one of less capacity, have variable speed. The motors for the four large pumps are each to be of 300 horsepower and the fifth to be of 200 horsepower. All are of open slip-ring wound rotor type with current at 2,200 volts, 3 phase, 25 cycles. Between each pump and the venturi meter is installed a 36-inch gate valve to be operated by electricity, of the inside-screw, double-seat type and able to withstand a pressure of 50 pounds per square inch.

Each venturi meter will be provided with a device to indicate rate of flow and record both rate of flow and total amount passed.

The pump room floor is about 12 feet below mean lake level and precautions are taken to make the substructure of the pumping station waterproof. The concrete walls are 3 feet 9 inches at this depth and 24 inches at the top, which is about 8 feet above mean lake level. The outside of the outer walls are to be covered with two swabbings of a tough, rubbery, asphaltic bitumen having a melting point between 165 degrees and 180 degrees Fahrenheit.

THE DISCHARGE SEWER

Outside of the building, where the three discharge channels terminate at the beginning of the

discharge sewer, provision is made for placing stop planks in either of these three channels.

The discharge sewer rests upon piles placed in bents 6 feet apart between centers, each bent consisting of 3 piles capped with a reinforced concrete beam 12 inches deep.

The sewer enters the skimming tank with its invert 7 feet above the bottom of the vertical side walls of the tank. The bottom of the tank is hopper-shaped, sloping about 3 feet 10 inches lower than the bottom of the vertical wall, from which depth the 60-inch outlet pipe leads off. Surrounding the interior of the walls of this tank is a gutter 5 feet wide and 3 feet deep, one side of which acts as a weir for drawing off excess flows. The top of the weir is about 3¼ feet above mean lake level.

Just outside the skimming tank the outfall sewer drops quickly 9 feet, and then falls 3¼ feet in a length of about 550. Here a branch extends upstream and another downstream, each consisting of 80 feet of 42-inch, 95 feet of 33-inch and 40 feet of 18-inch concrete pipe. At intervals of 48 feet along these branches are outlets in the top of the pipe, each outlet being 16 inches square and so formed as to discharge the sewage horizontally at right angles to the pipe. The 18-inch pipe ends in a cast iron elbow rising 30 degrees in a vertical plane. These outlet branches are set in trenches, dredged in the river bottom, 40 feet wide on the bottom and with slopes of 1 on 2, 10 to 20 feet deep below the present river bottom. This provides for discharging the sewage at ten points in a distance of 432 feet.

Note: In the larger table on page 521 of the previous instalment, the names of the cities referred to were omitted. These were, in the order of the columns: Toledo, Milwaukee, Detroit, Buffalo, Cincinnati, Louisville and Fitchburg.

American Water Works Convention

Papers read before the American Water Works Association at the Cleveland Convention described very briefly, and discussion of them and of the "Superintendents' Day" topics.

The papers read at the convention of the American Water Works Association followed almost exactly the program prepared, except that time was not found for three of the nine listed for the opening session on Tuesday morning, to be delivered by members of the local water works department.

A. V. Ruggles described the construction program of the Cleveland water works, L. A. Quayle gave some calculations comparing the relative cost of a reservoir on the one hand and of additional pumping equipment on the other for supplying peak demands. As a conclusion of this calculation he secured certain algebraic expressions for the amount of money that could be expended in building a reservoir, the ultimate cost of which would be no greater than that of providing pumping capacity to meet peak demands, basing his calculations on four types of pumping plants. His general conclusion was that a reservoir or standpipe capable of taking care of the largest part of such demands would in most cases be cheaper than additional pumping capacity.

G. E. Flower described, by the aid of lantern slides, the growth of Cleveland's water works. J. W. Ellms gave the results of a sanitary survey made by him of Lake Erie immediately in front of the city for the purpose of determining the best location for intakes for the new water works; his conclusion being that the locations of the present intakes probably could not be improved upon. The investigation consisted chiefly of repeated bacterial examinations of surface and subsurface waters during a period of several weeks, samples for analysis being taken at the corners of rectangular sub-divisions of that part of the lake under investigation.

Mr. Ellms and W. C. Lawrence had prepared a paper describing investigations made to determine the causes of obnoxious tastes and odors that sometimes occurred in the Cleveland water supply. They concluded that there was little doubt that these were due to the action of chlorine (used for sterilizing) upon minute proportions of tar products which found their way into the lake from certain manufacturing plants.

Mr. Ellms and A. G. Levy described tests made by them with different methods of dissolving sulphate of alumina. They concluded that stirring by paddles or otherwise was unnecessary, but that equally good and rapid results were obtained by merely passing water upward through alum supported on grids or otherwise in the bottom of the tank; the rate of solution depending upon the fineness of the alum particles.

Discussion of these papers had been postponed until all of them had been read and they were then discussed briefly by Messrs. Habermeyer, J. N. Chester and C. A. Brown. Mr. Chester inquired whether, in making the calculation comparing reservoirs and pumping systems, any provision had been made for meeting the requirements of the National Board of Fire Underwriters for fire protection, the reply being that this had not been taken into account. Mr. Brown suggested that instead of a grid for supporting the alum, a hopper bottom might be used with the water entering at the bottom of the hopper and spreading out so as to rise through the alum for the full area of the tank.

TUESDAY AFTERNOON

In the afternoon George H. Fenkell read a paper entitled "The Waste of Water in Detroit," which showed the excellent results obtained there by

the pitometer survey and other efforts of the department. (This paper will be published in PUBLIC WORKS.) This was discussed by Messrs. Brush, Bohman and others.

This was followed by two papers on water rates, one by Nicholas S. Hill, Jr., and the other by E. E. Bankson. After some discussion the authors agreed that there was little difference in the fundamental ideas embodied in the two papers, although they treated the subject from different viewpoints. Mr. Bankson's paper described in some detail the method recommended by him for determining the water rates necessary to enable any given plant to meet its operating costs, overhead charges and other elements of the cost of the service, at the same time alloting to service charge and quantity charge, respectively, the proportionate parts of the total charge which were at the same time logical and practicable. These papers were followed by considerable discussion by Messrs. Hazen, Brush, F. T. Kemble, Ledoux, Burgess and others.

TUESDAY EVENING

The evening session was an innovation for this society in that it was occupied by papers presented by associate members of the society. The first of these was by Charles H. Ade, of the National Meter Company, a considerable part being devoted to a humorous reply to the president's address at the 1920 convention, but later making a plea for the use of water works supplies by water departments without waiting for a further fall in prices, with the suggestion that unless such aid was rendered very soon many of the companies would go out of existence.

Peter Payne Dean described the Payne Dean electrical method of controlling valves, describing installations in connection with standpipes, where the valves were opened and closed from a distance, large valves which were closed much more quickly than would be necessary by hand closing, and other conditions where this control had been used successfully.

F. V. Leopold, of the Pittsburgh Filter & Engineering Company, described the experience of that company in developing the heavy oil engine, warning anyone contemplating the development of a similar appliance that they must be possessed of an abundance of money and patience if they expected to perfect a machine that would be practically successful.

The final paper was entitled "Standardization of Meters," by R. K. Blanchard, of the Neptune Meter Company. He told of the co-operation, which was hastened by war conditions, of the various companies in standardizing sizes of fittings, threads, capacities, etc., of meters of different kinds and makes.

WEDNESDAY MORNING

On Wednesday morning, following the president's address, Col. George A. Johnson read a paper entitled "The Romance of Water Storage," which made a plea that sole reliance should not be placed by any plant upon chlorination, but that all surface supplies should be filtered. This paper was discussed by Robert Spurr Weston, A. H. Jewell, Richard Messer and others. The water works of Erie, Pa., were described by John N. Chester. In response to a question by M. N. Baker, Mr. Chester stated that the water commissioners who are in charge of the water department of that city are appointed by the county judge, and are thus entirely free from control of city officials and presumably of politics.

Helman Rosenthal, of Dallas, Texas, described some animalcules having many of the characteristics of fleas that developed in enormous quantities on the water works filters of that city. After trying various methods of getting rid of them, the use of liquid chlorine applied before the water was sent to the filters was found to be effective.

Following this, reports of several committees were received. J. M. Goodell, secretary of the Committee on Standard Form of Contract, reported progress for that committee and the committee was continued. The committee on Private Fire Protection Service stated that it had no changes to make in its report of last year, and that it would render a final report next year. The committee on Standard Brass Fittings reported progress. The committee on Revision of Standard Specifications for Cast Iron Pipe and Specials reported that no decision had yet been reached as to the question of uniform outside diameter and other proposed changes, the general opinion of those consulted having been that this was not a suitable time to change specifications, especially in view of the increase in cost which such changes might necessitate.

WEDNESDAY AFTERNOON

An interesting paper was read by Abel Wolman entitled "The Small Plant Operator as a Scientist"; another by H. W. Streeter on "The Loading of Filter Plants," and one by W. A. Sperry discussing "Tastes and Odors with Chlorination."

In a paper entitled "The Quality of Water at Different Points on a Water System," written by Sheppard T. Powell and given in abstract in his absence, it was stated that B coli had been found in an open reservoir of the Baltimore County Water Company, although not present in the water as it flowed into the reservoir, and investigation apparently established that tadpoles were responsible for these B coli, their occurrence having coincided quite closely with the refusal of permission formerly granted to gunners to shoot frogs in the reservoir.

In a paper on State Versus Local Viewpoint on Filter Plant Control, R. B. Morse, chief engineer of the Maryland State Board of Health, made a plea for co-operation and a mutual toleration between local health officers and the officials of state boards. Mr. Goodell, in the absence of the authors, read a paper by Lewis O. Bernhagen entitled "The Education and Training of Water Plant Operators," and one by Charles H. Capen, Jr., entitled "Licensing Filter Plant Operators in New Jersey." Mr. Bernhagen, of the Texas State Board of Health, stated that health officials in that state spent two weeks a year at Austin receiving instructions from the state board in the operation of water purification plants.

Discussing the matter of tastes and odors due to chlorination, N. J. Howard, of the Toronto Filtration plant, stated that they had traced such tastes to phenol compounds; and H. P. Bohmann, of Milwaukee, stated that tastes in that city had been traced to a coke plant which discharged coal tar derivatives into the source of supply. Investigation showed that of the many substances tried, only coal tar derivatives gave the specific taste noticed. He stated that tastes that were due to chlorine alone can be removed by boiling the water, but where the taste is due to phenol the taste cannot be so removed. Mr. Morse stated that at two places in Maryland where tanks had been painted with coal tar paints, tastes were found in the water when chlorine was used. One member expressed his opinion that in many cases operators got careless and used too much chlorine, with the idea of thus making up for a carelessness in operation of the filter plants, and that the taste was frequently due to the excessive amount of chlorine. The subject was discussed by several others, including Messrs. Kent, Orchard, F. W. Green, E. I. Roberts, Jordan, A. U. Sanderson, Allen Hazen and others.

Mr. Jordan called attention to the fact that the Public Health standard of purity of water was not intended for municipalities but only for interstate carriers, but that in spite of the frequent repetition of this statement, many municipalities continued to use this standard. One of the speakers having made the statement that filters of 10 or 15 years ago, without the aid of liquid chlorine or certain other modern refinements, turned out regularly as high quality of water as the present standards demand, Mr. Hazen gave figures to show that the bacterial standards of the present were much higher than those commonly demanded in 1897.

SUPERINTENDENTS' DAY

On Thursday morning the report of the committee on Standard Specifications for Water Meters, Caleb M. Saville, chairman, was introduced for discussion, having been published in the journal of the association for May. There was no discussion and the report was adopted by the convention.

Fred B. Nelson described "A Method of Determing by a Single Flow Test of a Meter Its Capacity at all Pressure Losses." This was done by making the assumption, which he said was almost exactly correct, that the capacity of the meter varied as the square of the pressure. The greater part of the paper was devoted to showing how, by the use of logarithmic paper, the capacity at any pressure loss could be determined by making one test and plotting a line through the point plotted from this test and having a slope of two to one, and other uses of logarithmic paper. In connection with the matter of measuring water, a member asked Mr. Nelson how closely weir results and pipe flow results would check with the standard formulas; replying to which E. S. Cole stated that for a weir, results within one-half of one per cent could be obtained.

The paper on the program entitled "Use of Dynamite in Breaking Out Old Water Mains" had not been furnished for presentation. B. F. O'Brien in a paper entitled "Tapping Large Steel Mains Under Pressure," stated that to do this successfully required close attention to a number of details. Steel pipe is never truly cylindrical and to get a cast iron collar that would fit its circumference at any point, it is necessary to get a true contour at this point, this including the correct horizontal and vertical diameters, the thickness of the lap, the height of rivet heads, etc. A pattern is made of the section where the collar is to be placed and a casting made of semi-steel (about 20 per cent steel). The collar or sleeve is then set carefully with uniform lead space around the entire circumference, the lead is poured very hot and is calked carefully, going entirely around the circumference several times so as not to deform the pipe. In cutting the hole in the pipe, it is necessary to feed the cutter slowly, carefully and continuously because of the comparative flexibility of the steel. Questioned whether leadite or similar material could be used for calking, Mr. O'Brien recommended lead only.

At this session members were asked to discuss some of the 39 topics suggested. In connection with the third—"Experience with Double Check Valves Between Public Water Supplies and Polluted Private Fire Protection Supplies"—Mr. Ackermann told of his experience in Auburn several years ago, stating that maintenance of the efficiency of the double check valve requires inspection at least once a year, when each check valve should be taken apart, inspected and cleaned. Several members discussed the question, one of them stating that in one instance even deep wells used for private supply by a commercial plant had been found to be polluted and contaminating the public supply, and the general opinion seemed to be that certain safety required total absence of any connection between the two.

Discussing the fourth topic—"Extension of Water Mains into New Developments, How Provided and Paid For"—Mr. Gwinn said that his company required real estate developers to furnish cash in advance for such extensions. Mr. Brush said that in New York, extensions were granted by the municipal plant if there were enough houses along the line to average one for each 100 or 150 feet of main. In his opinion, however, decision should be based rather upon number of families rather than upon the number of houses, since one four-family house would use more water than two one-family houses.

(*To Be Continued*)

Road Construction In Ohio

The State Highway Department of Ohio is reported to have under contract more than one thousand miles of new highways, and much of this under construction. This includes about 293 miles awarded on May 27. On January 1, 1921, there was still uncompleted about 721 miles of work under contract. More work is to be let in July. All of this is only about one-eightieth of the total state and county highways already improved or to be improved. The aggregate cost of work now pending exceeds $36,000,000.

Excessive Motor Truck Taxation and Restrictions

In an article entitled "Transportation Equality," M. L. Pulcher, vice-president and general manager, Federal Motor Truck Company, says, in part:

"Many states are proposing legislation to limit the load that can be carried by a motor truck to such a degree that thousands of firms and men now owning heavy duty equipment will be forced out of business, and the capital invested in their trucks will be almost a total loss. Also, state and national taxation of motor trucks and passenger cars is being carried to an unreasonable point.

"Motor trucks hauled 1,200,000,000 tons of freight in this country in 1920; that carried by the railroads in the same twelve months amounted to 2,504,000,000 tons, most of the goods hauled by the trucks being also hauled by the railroads.

"As far as traffic laws are concerned, motor truck manufacturers and motor truck operators are agreed that there should be laws governing the gross weight, width and length of vehicle and load, and that the first of these, the weight, should be on the tire-inch basis, but they feel that all states should have a uniform law. Much motor trucking to-day is interstate, and as they are regulated to-day, operators never know whether they are breaking the laws until they are held for some infraction. Indeed, in many states the laws are so unreasonable that all truck owners are automatically infringing on the regulations.

"The Federal Highway Council Uniform Road Law is eminently fair, we believe, to all roads and to all truck owners. This law limits gross weight to 28,000 pounds and 800 per tire-inch, and speeds on pneumatic tires up to this limit of weight to 25 miles per hour. Lesser speeds are provided for different weights on solid tires. Fifteen states have already adopted this law, which is endorsed by many highway officials and associations. Legislation that limits weight and speed of motor trucks should be the same the country over, the same as that governing rates on common carriers. These laws, properly enforced, would then govern truck operation properly, present undue injuries to the road and be fair to all concerned."

WELDING T-CONNECTION TO PIPE WITH OXY-ACETYLENE TORCH

Oxyacetylene Torch for Pipe Welding and Cutting

Economy, convenience, efficiency and rapidity of welding vs. screwed joints. One man and simple outfit can weld 8-inch pipe joint in twenty minutes with maximum cost of 14 cents for gas.

The successful use of the oxyacetylene torch for welding and cutting all sorts of material in manufacture, construction and repair work has developed a large and increasing application to the field welding of joints in gas mains and other pipes instead of making them with screwed sleeves.

Welding the joints is a simple, easy operation, quickly learned by an intelligent workman and rapidly accomplished under ordinarily favorable conditions. It involves no expensive equipment or elaborate operations and is estimated to cost from 30 to 60 per cent less than an equivalent screwed joint, besides often permitting the use of a pipe considerably lighter than is required for screw joints.

The welded joints eliminate flanges, sleeves, extensions and many special fittings of the pipe, permit the joining of pipes at any angle, make a connection as strong as or stronger than the body of the pipe, and are perfectly watertight and gas-tight. They are applicable to all kinds of metal and greatly reduce or eliminate electrolysis that is often destructive to screwed joints.

APPARATUS

The equipment consists of a 220-cubic foot tank of oxygen at a pressure of 2,000 pounds per square inch at 70 degrees Fahrenheit and a 275-foot tank of acetylene gas at a pressure of 250 pounds per square inch at 70 degrees Fahrenheit, equipped with hose, gauges, reducing valves and standard torch, and mounted on a hand truck, the whole weighing about 400 pounds and being portable so as to easily follow the pipe line.

Standard pipe of any diameter, with the ends bevelled to an angle of 45 degrees, is assembled together with the ends rigidly held concentric and a small fraction of an inch apart to allow for expansion, and the joints are welded either in the trench or, preferably, on the surface alongside. The pipe should be supported high enough above the ground to give free access to the underside of the joints and should be revolved away from the operator, thus allowing him al-

ways to work on the upper side of the pipe, and bringing the completed portion of the joint always just above the flame of torch, which if held at an angle of 45 degrees, produces, without special effort, a joint semi-circular in cross section.

REGULAR OPERATIONS

Only one man is required to operate the torch, but he can be advantageously assisted by another to turn the pipe, although when necessary the joint can be carried around the pipe without turning the latter, an operation which it is estimated costs twice as much as when the pipe is turned, and if conducted in the trench costs 25 per cent more than if done on the surface of the ground.

The beveled edges of the joints expose the wall of the pipe to the easy application of the torch flame which quickly and uniformly heats the metal to the fusing point at the same time that it melts the end of a small rod of the same or a similar metal that is used to provide new material for the joint, the whole being fused into position and making a solid continuous filling integral with both ends of the pipe.

Large diameter pipes are first tack-welded together at four equidistant points while the pipe is stationary, after which welding is commenced at one of these points and continued around the joint, completing the work as the pipe is gradually turned on its axis.

JOINTS WELDED AND END SEALED OF LONG SECTION OF PIPE READY TO BE LOWERED IN TRENCH

It is customary to complete half a dozen joints making one long section on the surface of the ground adjacent to the trench, which is then placed in the trench and assembled with the last section at a point where an excavation is made in the bottom of the trench to give access for the operator. The joints are so strong that they are not injured by the moving and lowering of the pipe, and the stresses occasioned in this way are often considered allowable in order to provide practical tests.

TESTING

In a recent installation of 12-inch and 16-inch steel pipe for 3 miles of double line, and 3 miles of single line, installed in Pennsylvania for the Counties Gas and Electric Company, the joints were welded under the supervision of experts from the engineering service department of the Air Reduction Sales Company, New York, which supplies torches, oxygen, acetylene and other equipment for this class of work. In this job, 15 or 20, 20-foot lengths of pipe were welded together and then the ends were sealed by a transverse diaphragm plate welded on to permit the application of a 30-pound pressure test to detect leaks. After the satisfactory test the seal was removed and another length of pipe added, and so on.

COST AND SPEED

Under ordinary working conditions an expert operator using an Airco "A" Welding Torch equipped with a No. 4 Airco "A" Welding Tip can weld metal ⅛ inch to ¼ inch thick at a speed of 7 feet per hour with a consumption of 12.5 cubic feet of oxygen at a 2½-pound pressure and 11.5 cubic feet of acetylene at 3 pounds pressure.

With an Airco "D" Cutting Torch and No. 1 Airco Standard Cutting Tip the operator can cut through steel ½ inch thick at a speed of about 80 feet per hour, consuming in one hour 51.75 cubic feet of oxygen and 15.5 cubic feet of acetylene at pressures of 20 pounds and 3 pounds per square inch.

The cost of the gas varies according to the user's consumption, reaching a maximum of about $2 per 100 cubic feet of oxygen and $3 per 100 cubic feet of acetylene. In the case of acetylene it is necessary for the user to spend a nominal sum for the purchase of cylinders. The arrangement which Airco has in this connection is to loan its acetylene customers one additional acetylene cylinder for each one purchased. Thus if a man buys one cylinder he is loaned another, which arrangement gives him the service of two tanks at the cost of one. If he buys ten he is loaned ten more, etc. Cylinders are exchanged when empty.

The welding torch is used for numerous purposes in construction and repair work including the welding of steel pressure vessels which must be absolutely tight, for heating kettles, and many similar purposes. The cutting torch is used for cutting off the pipes, for bevelling their ends, and for cutting any structural steel, such as columns, girders, beams, angles, truss members and the like.

PUBLIC WORKS.

Published Weekly
by
Municipal Journal and Engineer, Inc.
Publication Office, Floral Park, N. Y.
Advertising and Editorial Offices at 243 W. 39th St., New York, N. Y.

Subscription Rates
United States and Possessions, Mexico and Cuba..$3.00 year
All other countries .....$4.00 year

Change of Address
Subscribers are requested to notify us promptly of change of address, giving both old and new addresses.

Telephone (New York): Bryant 9591
Western office: Monadnock Block, Chicago

S. W. HUME, President J. T. MORRIS, Treasurer
A. PRESCOTT FOLWELL, Editor
FRANK W. SKINNER, Associate Editor

CONTENTS

CONCRETE BRIDGE CONSTRUCTION—Illustrated 541

DESIGNING IMPROVEMENTS IN TOLEDO'S SEWERAGE 544

AMERICAN WATER WORKS CONVENTION.... 546

Road Construction in Ohio 548

Excessive Motor Truck Taxation and Restrictions.... 549

OXYACETYLENE TORCH FOR PIPE WELDING Illustrated 549

EDITORIAL NOTES 551
Taxing Motor Traffic—Field Construction Methods and Plant

COUNCIL ON STANDARDIZATION 552

Tests of Earth Concrete 554

Port Newark Dredging Started 554

HOW TO MOVE PIPE MAINS IN SERVICE..... 555

RECENT LEGAL DECISIONS 557

Taxing Motor Traffic

The hundreds of millions that have been spent in building roads have so far been raised, in most cases, by federal, state and county taxes or by bond issues to be paid off by such taxes. In some states the maintenance of the roads has been paid. for by motor vehicle taxes, but even this has not been universal. During the past year or two, however, the growing opinion that motor vehicles should carry a large part of the burden of road construction as well as maintenance has been embodied in the form of state laws, adopted or proposed. Naturally, many automobile owners and manufacturers are opposing this; such opposition was, of course, to be expected. The argument of one such is given elsewhere in this issue.

There are two general classes of motor vehicles —pleasure and business; the latter being again divisible into those for local town delivery and trucks for long-distance hauling. Perhaps one family in five owns a pleasure vehicle. If roads are paid for by taxes, the four car-less families help pay for the joy rides of the fifth. (It is generally recognized that rent and prices of food and clothing rise as taxes rise.)

As to the argument that good roads, by encouraging truck hauling in competition with railroads, benefit all by lowering prices, the question arises —do they? Do all benefit or only a few who are so situated or in such business as to be able to do so? Moreover, in the last analysis, is the benefit anything like as great as is generally believed? If the interest and maintenance costs of the roads of a state and an adequate depreciation be charged against the motor traffic of that state and met by an increase in rates for truck transportation, would the showing be favorable compared with rail freight rates? Unless it is, then a few are benefiting at the expense of the general taxpayers.

If and where trucks, after paying their share of all highway charges, can compete with railroads, they are an economic advantage and those pay who benefit. Under present practices it is undeniable that only a percentage of those that pay for good roads, directly or indirectly, benefit by them.

Where the roads and the truck travel over them tap a country that is not served by rail, then there is argument for a partial payment for the road by the district served and whose value is thereby increased. But here again this payment may be made directly in the form of taxes or indirectly in the increases in trucking charges made because of higher truck license fees.

Street railways expect to pay the entire cost of their track and frequently give some service in return for the privilege of using the street. Railways pay the entire cost of both right of way and track. We see no reason why trucks, using the roads for commercial transportation, should not pay their share of the entire cost of construction and maintenance of such roads.

Field Construction Methods and Plant

In municipal work and other kinds of public engineering, there are always two separate but closely related factors—design and execution. Technical colleges have gone to the practical limit in training their students in science and mathematics and in the preliminaries of design. Great machine shops and commercial corporations have highly developed fabrication and machine construction, but comparatively little has been standardized or made available for the ready presentation to the layman student or young engineer of the important features and accepted practice in the field of construction of important public works.

A proper co-ordination of design and construction is essential for safety, economy, rapidity and efficiency. Field construction, although it includes a great variety of work under widely different conditions and with all sorts of appliances,

and demands great courage, ingenuity and experience, can be classified in a comparatively small number of major divisions and is executed almost entirely with standard plant and equipment, the proper uses, combinations and modifications of which are indispensible factors of successful operation. These things are of great variety and are interesting, often spectacular, and are of such importance that space is given in PUBLIC WORKS to many articles describing the building of various municipal structures, and through the department of Construction Questions Answered.

The character of such work, the ordinary requirements, the difficulties most likely to be encountered, the methods which have been developed for executing the work, the plant and equipment that is available for it, the machinery, tools and operations that have become standardized and their applications as illustrated in the building of all sorts of civil engineering structures in this country have been observed, recorded and many of them published in descriptive articles by Frank W. Skinner, associate editor of PUBLIC WORKS, who has prepared these data for student instruction and presented to them before the war in occasional or regular lectures at many engineering colleges. A few of the 40 lectures prepared were revised and delivered this spring at the College of Engineering at Cornell University.

As the data included in them make substantially a review of important features in the special field of PUBLIC WORKS, abstracts of some (omitting most of the illustrations of standard, notable and difficult examples and the repetition of details of the kind always abundantly presented in these columns) will be presented in this and in subsequent issues for the benefit and convenience of the younger engineers and contractor and for the many who have little or no time or opportunity for familiarizing themselves with the essentials and general features of special kinds of work which they are not called upon to specialize in but which they may without warning be called on to consider.

Council on Standardization of of the A. W. W. A.

Report that promises to reform a large part of the committee work of that society.

While the report to the convention of the American Water Works Association made by the Council on Standardization was brief and the discussion of it occupied but little of the time of the convention, the seriousness with which the council has taken up its work and the indications conveyed by the meeting of the council and the proposed committees on the day preceding the convention, all point to the probability that the work of this council will play a very important part in the future activities of the association.

As it states in its report, "The council regards itself as a committee on committees for those subjects which involve standardization matters"; and it includes among such subjects, methods of water analysis, drinking water standards, load factors for purification plants, colloid chemistry, watershed protection, industrial wastes, pumping station betterments, and in fact, nearly the entire range of subjects that generally come up for discussion at conventions of water works associations.

The council suggests two lines of action for the committees—the making of investigations and the abstracting of reports and papers on current developments. In order that the former may be carried on with success it will be necessary in most cases that some funds be available and suggestion was made during the convention that it might be possible to persuade some wealthy individuals to contribute funds for this purpose, these funds to be expended by a department of water works established in one of the engineering schools. This certainly seems to be a practical suggestion and it is to be hoped that a public benefactor may be found who will make this possible.

We do not understand that it is the idea of the council that the committees proposed by it would monopolize the entire work of the society or take the place of the papers which it is customary to read and discuss at the conventions. It should, however, result in the presentation of committee reports that would be of real value and not merely those of "progress," which word so often means inaction. The abstracts presented by the various committees should be of the greatest value in giving to the members of the association a general knowledge in condensed form of the important events that have taken place in the water works field. These would be published from time to time in the "Journal" of the society, rather than being presented only annually at the convention. To the average water works man it is probable that these abstracts appearing regularly throughout the year would be of more interest, and possibly of more practical value, than the occasional reports of investigations, although the latter might well become prominent as stepping stones in the progress of water works matters.

It is to be hoped that the interest which the society appears to have taken in the work of the council on standardization will not be allowed to die down and that during the coming year the work of the several committees may become organized and a start at least be made in the practical carrying out of the lines of committee work indicated.

Report of Council on Standardization

The Council on Standardization, which was established by the association at Montreal in 1920, has been outlining its work by conference and by correspondence. It has considered it much better to develop a working program which is flexible, yet comprehensive, rather than to have appointed at once a large number of committees without well-defined purposes and with personnel selected without the full consideration desirable. It has

been certain from the outset that no program should be laid out which cannot be followed by committees with individual resources at the command of their members, by the help the association can give, and by the assistance that reasonably can be expected from other sources.

In general, the committees will find it useful to function in two ways. The first is to carry on actual investigations, which may not furnish much information except at intervals. The second is to prepare for publication in the "Journal" brief abstracts of the reports and papers on current developments of importance to the members. The publication of such abstracts can be made of high educational value, and their preparation is an excellent way to secure the co-operation of some of the younger members in committee work. It is suggested that the association should compensate the members who do this work at the rate of about half a cent a word for the abstracts as printed. For some years it is probable that this abstracting of information will be the most productive educational feature of the council's work.

It is expected that each committee will first lay out a program for carrying on the work assigned to it, and will then take up this program with the council. When it has been developed to the satisfaction of the council, the latter will take steps to gain for it the support of the association. The council believes that "practical" committee work should be carried along simultaneously with research, so that water works operators will get the maximum possible benefit as early as practicable from the council's activities. Furthermore, this program will make it practicable for each committee to carry its work forward in the speediest way to the point where the experience of the practical water works men can be drawn upon in order to couple theory and practice in the most helpful way. In this manner a large number of our members will be joining co-operatively in improving water works practice.

The council has held conferences here at Cleveland and has reached the conclusion that the committee work outlined in the attached program should be undertaken. In order to carry it on properly, the council has asked the finance committee to place $2,000 to its credit in the 1921-1922 budget.

The council regards itself as a committee on committees for those subjects which involve standardization matters. It will be the committees and not the council which shall be given the credit for actual performances, while to the council will fall the task of co-ordinating and stimulating actions along practical lines and of avoiding duplication of effort. It is not to be expected that each committee will produce, year by year, reports of great importance, but it is hoped that all committees will put before the membership concrete statements of progress made in their respective fields, expressed in such a manner as to be readily understood by those interested in a practical way in these subjects.

To get the abstracts under way, a committee consisting of A. L. Fales, J. N. Chester, F. C. Jordan, R. S. Weston and A. Wolman has been appointed to report to the council by September 15, 1921.

It is understood by the council that such portion of the funds to be reserved for its use as will not be actually necessary will be available for other activities authorized in the association budget for the year 1921-1922.

Attached are the topics and personnel of the committees which have been established with the understanding that each committee has the authority to extend its personnel as it deems necessary.

Mr. Malcolm Pirnie, of Hazen, Whipple & Fuller, 30 East 42d street, New York, has kindly consented to act as secretary of the council.

George W. Fuller, Chairman.
Frank A. Barbour,
Edward Bartow,
George A. Johnson,
George C. Whipple,
Council on Standardization.

Topics and Personnel of Committees

1. Standard Methods of Water Analysis—five members—Jack J. Hinman, Jr., chairman, Iowa City, Ia.
2. Standards for Satisfactory Drinking Water—five members—A. W. Freeman, chairman, Columbus, Ohio.
3. Practical Ranges in Load Factors for Purification Plants—five members—E. E. Wall, chairman, St. Louis, Mo.
4. Colloid Chemistry in Relation to Water Purification—twelve members—R. S. Weston, chairman, Boston, Mass.
5. Watershed Protection—five members—Theodore De L. Coffin, chairman, New York, N. Y.
6. Industrial Wastes in Relation to Water Supply—six members—A. L. Fales, chairman, Boston, Mass.
7. Pumping Station Betterments—four members—Leonard A. Day, chairman, St. Louis, Mo.
8. Physical Standards for Distribution Systems—five members—G. G. Dixon, chairman, Akron, Ohio.
9. Standardization of Services—five members—J. M. Diven, chairman, New York, N. Y.
10. Sanitary Fountains—five members—J. H. Dunlap, chairman, Iowa City, Ia.
11. Testing of Water Works Materials and Supplies—five members, John H. Gregory, chairman, Baltimore, Md.
12. Methods and Records of Water Waste Control—five members—W. W. Brush, chairman, New York, N. Y.
13. Steps Towards Standardizing Stated Quantities for Slides in Meter Schedules—five members—Allen Hazen, chairman, New York, N. Y.
14. Practical Standards of Rules and Regulations of Relations Between Water Works and Consumers—six members—F. C. Jordan, chairman, Indianapolis, Ind.

15. Essential Data for Water Department Records and Reports—(a) Municipal Plants—five members—George H. Fenkell, chairman, Detroit, Mich; (b) Privately Owned Plants—five members—John N. Chester, chairman, Pittsburgh, Pa.

Tests of Earth Concrete

A few days ago we received the following letter from Duff A. Abrams, of the Structural Materials Research Laboratory, referring to an article that appeared on page 431 of our May 21 issue. We submitted this letter to the Earth Concrete Co. for reply, and append the reply of the president of that company. The copy of the original report of the research laboratory that he sends differs from that published by the company in its circular and copied by us only in the heading. In the copy sent with the letter the words "Taken from Knapp Road, Grand Rapids, Kent County, Michigan," do not appear, but in their stead the words: "For Race J. Macklin, 19 North Clark Street, Chicago, Ill." The description reads as follows: "One block was received. It was cut into five smaller pieces of suitable size for testing. The tests of the four small blocks were made in a 40,000-lb. Riehle testing machine. The large block was tested in a 200,000-lb. Olsen testing machine. The bearing surfaces of the blocks were capped with Plaster of Paris to insure an even distribution of the load. The load was applied through a spherical bearing block."

The copy of the report from the United States Department of Agriculture gives, as the result of the compression test on two samples, one 6⅛ by 6⅛ by 8 and the other 6 by 6 by 8½, a strength of 2,438 and 2,213 pounds per square inch, respectively, averaging 2,325 pounds. Date of test, April 12, 1921.

Structural Materials Research Laboratory
Lewis Institute
1951 West Madison Street, Chicago

Public Works,
New York City.

Gentlemen: Your issue of May 21 contained a report on the use of Earth Concrete which purports to be a copy of a report of tests made by this laboratory. It should be stated that our report has been modified in such a way as to give an entirely different impression from that conveyed by the original report. Your article states that the material tested was taken from the "Knapp Road, Grand Rapids, Kent County, Mich." Our report contained no such statement. We had no information concerning the origin of this material, nor did our report indicate its origin, except that it was submitted by the Earth Concrete Company.

We consider the above-mentioned modification of our report as a deliberate falsification of its contents. We trust you will find it convenient to give the same publicity to this statement that was given to the above-mentioned report.

Tests carried out in this laboratory at 7 and 28 days on mixtures of cement and sand and cement and soil with and without "earthcrete" shows that the "earthcrete" *reduces* the strength rather than increases it.

Yours truly,

D. A. Abrams.

June 17, 1921.

Editor, Public Works,
243 West 39th Street, New York, N. Y.

Dear Sir: We have your esteemed favor of June 15 with which you enclosed a copy of a letter from D. A. Abrams, Lewis Institute, Chicago, in which he objects to an article which appeared in your journal of the issue of May 21, 1921.

The objection to the article seems to be for the reason that your paper used a laboratory report which was used in one of our circulars, in which we inadvertently referred to the samples which were tested as being taken from "Knapp Road," near Grand Rapids, Mich., a highway built by the Board of Road Commissioners about a year ago; the road was constructed of red clay in which cement and Earthcrete was used, and it is meeting all expectations and taking traffic wear just as well as the regularly constructed concrete slabs which adjoin; it seems to be getting more durable with age, thus supporting our contention that more time must be given samples containing our chemical than is allowed for 7 and 28-day tests; laboratory tests do not tell the tale.

The tests made by the Lewis Institute were from samples cut from a slab taken from this road and shipped direct from this office to the Lewis Institute, in care of Mr. Race J. Macklin, our Chicago representative. We are submitting for your use in the publication of any controversy which may arise from Mr. Abrams' objection, a correct copy of the report received by Mr. Macklin from the Lewis Institute, and from which report the circular matter was taken; you will note that the two reports do not differ except that we did inadvertently use the words "Knapp Road" when we really should have said EARTH CONCRETE. Seems to us that this is a small matter to raise such a hub-bub about. Further, we did offer this same explanation to Mr. Abrams, and discontinued mailing the circular in the form in which it was originally printed; we repeat now that we have no intention of taking any undue advantage of either Mr. Abrams or the Lewis Institute; we have the report that was made on the block taken from the Knapp Road, and we would like to know if it is necessary for this company to furnish an affidavit that the sample did come from that particular construction, and if it is required that Mr. Macklin be called upon to identify the same. Of what particular good is a laboratory test unless it can be made use of?

We are enclosing for your further use if you require it a test made by the United States Department of Agriculture, Bureau of Public Roads, in which the results run almost parallel with those of the Lewis Institute; they do not hesitate to note on their report that the source of material was "Knapp Road, Kent County, Michigan."

We do take decided exception to the statement made in the second paragraph of Mr. Abrams' letter that he considers the "Modification a deliberate falsification of its contents."

In the last paragraph he compares our product with samples tested under laboratory tests made in seven and in twenty-eight days; we contend that this is not giving us a fair test inasmuch as we have a new method of construction by the use of chemicals, and that old and worn-out methods will not apply to new ideas; longer time is required to obtain the petrifying effect of earth matter which we hope to show the scientific world is what we will accomplish.

We thank you for your letter and the information which you have imparted, and trust that if the Abrams' letter is published, ours will appear also.

Very respectfully yours,
Earth Concrete Company,
R. S. Greenwood, President.

Port Newark Dredging Started

Work was started a few days ago by the Atlantic, Gulf & Pacific Co. on dredging a ship channel for Port Newark, on the Jersey meadows, and filling in the marsh land of the meadows. This will give a channel 30 feet deep and 200 feet wide to permit ocean steamers to reach the docks and warehouses that it is proposed to build on the meadows. The dredging contract is for $739,062, while $133,397 is to be spent for bulkheads to retain the filled material. The work will require about one year.

Construction Questions Answered

Suggestions as to methods, "wrinkles" and appliances that may be used to overcome difficulties arising in construction work. We invite questions concerning such problems that may arise from time to time in the experience of any of our readers. Answers prepared by competent authorities will be published promptly. It is hoped that others who have solved similar problems differently will send us their solutions for publication also; or describe new "wrinkles." If it is only a new way to drive a nail, it may help some one.

How to Move Pipe Mains in Service

May be lowered in trenches by tackle, screw rods, wedges, by jacks or undermining. Submerged pipe lowered by lifting, shifting and slacking off or by pumping.

Pipes of small diameter are relatively so light and their joints are so strong and comparatively flexible that they can be handled with considerable ease and without developing strains likely to threaten their safety. They can therefore have their support removed for comparatively long distance and can be raised, lowered or otherwise shifted without special appliances or application of great power and can even adapt themselves to moderate variations of alignment without serious difficulty so that their lowering or otherwise shifting generally requires merely care and the intelligent use of ordinary facilities, especially if the pipe is above ground or is conveniently accessible by trenching.

For diameters above 6 inches, the weight and rigidity of the pipe increase rapidly while the proportionate strength of the joint decreases while the mass and weight of the mass to be handled are much greater, the operations more difficult and costly, and the risk of injury to the pipe is much increased, often special apparatus is required, or unusual methods and great care, involving considerable expense, especially if the pipe contains liquid under heavy pressure that would cause damage if released, or if it contains steam or gas, leakage of which might have injurious effects or cripple the system which it supplies.

In some cases if the pipe is not in good condition it may be safeguarded by reinforcing before any attempt is made to handle it when under very high pressures, or in specially disadvantageous locations. Where the displacement is very great or very abrupt it may be necessary or advisable to bypass the service entirely and to remove a given section of the pipe bodily and reinstall it in the new location, as has occasionally been done for service pipes for gas and water in New York streets, where it was necessary to displace them a considerable distance transversely to clear the construction of subways, sewers and other subterranean work. Pipes for the underground tubes for pneumatic postal delivery in New York City required such perfect installation and alignment that, in some cases, no attempt was made to lower them in service, but they were temporarily replaced by other lines until the final alignment could be installed in its permanent location.

SHIFTING SMALL PIPE

The first step is to completely expose the pipe for inspection and any necessary preliminary operations along the full length which must be lowered. This, of course, involves opening a trench deep enough and wide enough to extend to the bottom of the pipe on both sides permitting a thorough examination and giving access to all portions of the pipe. In a large number of cases the pipes have to be lowered a comparatively short distance, perhaps only a foot or two, or to be shifted a similar distance horizontally, or both, to clear a certain obstacle, which can often be done without disconnecting the pipe, by swinging it from a straight line to a long curve, providing the required offset at center and becoming tangent with the original alignment at both ends of the shifted section, which may then be somewhat longer than the portion that is required to be displaced so as to secure small angles of divergence and avoid serious stresses in the pipe or joints. When a long section of moderate size pipe is uncovered it can generally be moved transversely a short distance in the middle by pushing it with bars, wedges or jackscrews, great care being taken to watch the joints and see that no leaks or excessive strains are thus produced.

PIPE UNDER HEAVY PRESSURE

If the pipe is under very heavy pressure, as sometimes for a high pressure fire line or for hydraulic service or for a steam line; or if for any reason a leak would endanger the workman or the safety of adjacent property or of the pipe system itself or its service, great pains must be taken to avoid the possibility of broken pipes or joints due to a change of conditions and very reliable support must be provided before the original support is impaired, reaction abutments at bends must be inspected and reinforced, if necessary, and joints that may possibly become loosened should be secured by collars or clamps on both sides connected by tension bolts to prevent a possible opening there. If the pipe is of very large diameter, or under very heavy pres-

sure, or in a critical position, the operation should be directed by experts and in accordance with careful calculations of the strength of joints, the stresses that may be developed, and the work done according to an exact schedule of safe distances and operations.

In no case should there be any abrupt deflections in the pipe and the movement must be gradual, extending over a long distance from the undisturbed portion of the pipe to the point of maximum displacement and the movement of the pipe between these points must be made in numerous small increments, gradually increasing from zero at the ends, to the practicable safe limit at intermediate points and thence through the middle section of the pipe where they may be continued uniformly to a point where they begin to decrease in reverse order to the point of tangency with the undisturbed pipe.

LOWERING BY SAGGING

For small pipes, uniformly supported on hard, regular, sand, clay or earth, it may be possible to remove the earth to the depth of an inch or so, carefully determined by a gauge, from under the center of the section of pipe and working away from this point in both directions continue to remove it until the pipe sags down to rest on the ground or on blocks of a graded thickness placed under it for the full required length, after which the operation can be repeated again from the center, working both ways for shorter distances, and so on, until the pipe is lowered to a required position, sloping upwards at both ends at a very small angle to its original location. This cannot, of course, be done with very large or heavy pipe or where it is impossible to open the trench wide enough and deep enough to allow for the operations.

LOWERING IN SLINGS, TACKLES AND YOKES

Larger and heavier pipes up to 12 or 16 inches in diameter may often be conveniently supported by manila rope slings suspended at every joint and from beams laid across the trench on the surface of the ground. The slings are carefully pulled taut and securely made fast, and will hold the pipe suspended while the excavation is made under it to a moderate depth, say 1 or 2 feet. The excavation should immediately be followed by blocking and wedging at points close to the slings to support the pipe against any possibility of failure of the slings.

The blocking should be so arranged as to have room on top both for the wedges that actually support the pipe, and for second bearings adjacent to them, which should be carefully leveled up to given elevations very close to the pipe and varying accordingly to the profile of different lowering positions that may be prepared in advance. The wedges can be removed and the slings slacked off to lower the pipe to the new bearings, a new set of elevations prepared and the operation repeated, and so on, until the pipe is lowered to the bottom of the trench, when if it has not reached the required elevation it may be again supported and the trench extended to a convenient depth and so on, until the work is finished.

If the pipe is too heavy to be lowered by simple slings they may be replaced by tackles with the lead lines carefully snubbed on the cross timbers or otherwise arranged so that they can be quickly unfastened. For heavy pipe this method requires a large number of men and tackles, and the tackles may be advantageously replaced in some circumstances by yokes made with transverse pieces and pairs of vertical screw rods passing between pairs of the cross timbers on the surfaces of the ground and with nuts bearing on them through friction plates that are well oiled to facilitate their turning. The rods should be placed at every joint or oftener and afford a very sure and regular method for lowering the pipe, which is accomplished at any desired rate of speed by a large or small party of men, located at different regular intervals, and going from one end of the line to the other, each of them slacking off the nuts on one or both sides of the pipe from end to end of his section by a given number of revolutions or fractions of revolutions at a given signal, and then repeating, the amount being diminished or the operations omitted at the ends of the pipe in order to provide for the small angle between the tangent and the center of the pipe.

JACKING AND BLOCKING

Under some circumstances it may be desirable to drift small openings in the bottom of the trench under large, heavy pipes, and place cross beams or cradles in them, supported on jacks and cribbing, after which the bottom of the trench between the crossbeams can be removed and the proper bearing for the pipe in its new position can be provided and the pipe lowered to it by jacking down and removing the cribbing. This, of course, is a slow and expensive operation and necessitates the opening of a wide trench to give suitable working space.

REVOLVING CONNECTION

If a long section of pipe of moderate diameter is to be lowered several feet and it is permissible to introduce right angle bends in the pipe it may be practicable and economical to cut out this section from the remainder of the pipe and connect it back again at each end with a U made with four elbows and two straight lengths of 1-2 the vertical offset of the pipe. These elbows are at first connected up in the horizontal plane of the undisturbed pipe, after which the center section of the pipe being properly supported can be held in the original position while excavation is made under it to the required depth and the pipe can be then rapidly lowered to the new position, while the U's automatically revolve from horizontal to vertical position and extend themselves to their new arrangement in the vertical plane through the end and center sections of the pipe. This, of course, can only be accomplished with screw fittings that permit the revolution of the pipe in the elbow joints.

Recent Legal Decisions

PUBLIC WORKS CONTRACTOR'S BOND HELD NOT TO SECURE MATERIALMAN'S EMPLOYEES

The Washington Supreme Court holds, Neary v. Puget Sound Engineering Co., 194 Pac. 830, that one who contracts with a paving contractor to furnish all the sand and gravel needed in the performance of a paving contract is not a subcontractor, but a materialman, although the contract provides that delivery of the material shall be "on the ground as directed and required," and for replacement of any material rejected by the city engineer, and a bond is given to insure performance; therefore employees of such materialman cannot recover on the contractor's bond. The court said: "In many cases under modern conditions materialmen deliver their material upon the works where it is to be used. In our cities lumber and mill work are commonly delivered by the manufacturer to the place where they are to be put into the building, but that should be no reason for holding that the workmen employed by the mill are, if not paid their wages by their employer, entitled to file a lien against the building and the ground on which it stands. . . . The giving of a bond on a contract to perform public work is for the purpose of providing security for those who would be entitled to a lien if the work were private, and to claim under such bond one should be in a position to protect himself by a lien if the work were private in its nature. And therefore, if one employed by a materialman may not claim a lien when the work is of a private nature, he cannot claim under the bond given where the work is public."

DISCRETION IN CONDEMNING RIGHTS OF WAY FOR STREETS—MEASURE OF DAMAGES

Applying the rule that the necessity for condemning rights of way for the opening or extending streets is a matter which has been confided to the decision of the municipal authorities, and their judgment is conclusive upon the courts, unless it be made to appear that the use was palpably private, or the necessity for the taking was without any reasonable foundation, the Kentucky Court of Appeals holds, Louisville & N. R. Co. v. City of Louisville, 227 S. W. 160, that evidence which merely tended to show that there were other ways, both near and remote, by which the property in the section served might be reached is not sufficient to authorize the court to substitute its judgment for the judgment of the municipal authorities on the question of necessity. The suit was one by a city to condemn an easement for a street over a railroad right of way, and it was held that the railroad was not entitled to such elements of damage as the maintenance of a switchman's gate and house, and an annual expenditure for crossing protection, etc. The full measure of the railroad's just compensation was the difference in value between the exclusive and joint use of the right of way.

SINGLE OR DOUBLE IMPROVEMENT CITY SEWERAGE SYSTEM AND DISPOSAL PLANT

The Illinois Supreme Court holds, in a proceeding to confirm a special assessment to pay the cost of a system of sewers for a section of a city, City of Elmhurst v. Kohnert, 130 N. E. 761, that the sewer improvement was a single and not a double improvement, though it included storm-water sewers draining three natural watersheds. A city or village has the right by one ordinance to provide for a connected system of sewers and drains in and along its streets and avenues whereby they may be improved, and such a system is not subject to the objection that it is a double improvement. Walker v. People, 170 Ill. 410, 48 N. E. 1010. The construction of sidewalks on several streets may be provided for as one improvement if all property taxed therefor will receive some benefit from the proposed improvement. Storrs v. City of Chicago, 208 Ill. 364, 70 N. E. 347. The construction of another improvement to aid the purpose of the main improvement in contemplation will not render the improvement double for that reason, as in the case of the construction of a sewer for drainage purposes in a sidewalk improvement, or the establishment of pumping works in connection with a sewerage system in order that the latter may serve its purpose properly, or the construction of a disposal plant in order that the proposed system may accomplish its proper purposes. City of Staunton v. Bond, 281 Ill. 368, 118 N. E. 47; Drexel v. Town of Lake, 127 Ill. 54, 20 N. E. 38.

DISTINCTION BETWEEN RESOLUTION AND ORDINANCE

In a suit on apportionment warrants for a street improvement, the Kentucky Court of Appeals, in Robertson v. Southern Bitulithic Co., 227 S. W. 453, states the difference between an ordinance and a resolution to be that the former prescribes a permanent rule of conduct or government, while the latter is an order of the council of a special or temporary character. The ordinance is the more deliberative of the two and attended with the greater solemnity. In practical operation, however, the distinction between the two depends upon the formalities attending the adoption of the respective acts. Usually an ordinance cannot become effective or be adopted at one meeting.

Under sub-section 14, section 3235 C., Kentucky Statutes, authorizing the organization of a second-class city under the commission form of government, the construction or reconstruction of streets may be ordered by either an ordinance or resolution, so that the extension of time for the completion of work by a contractor on a street improvement may be granted by a resolution, notwithstanding section 3096, authorizing the general council of such cities to provide by ordinance for the improvement of streets and other public ways.

NEWS OF THE SOCIETIES

June 28 — ATLANTA SECTION, AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Election of officers. Georgia School of Technology, Atlanta.

June 28-July 1 — SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION. Annual convention. New Haven, Conn. Secretary, F. L. Bishop, Univ. of Pennsylvania.

July 15—NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Annual meeting. Crown Hotel, Providence, R. I.

Aug. 10-12—INTERNATIONAL ASSOCIATION OF STREET CLEANING OFFICIALS. Annual conference. Hotel La Salle, Chicago, Ill.

Aug. 23-25—AMERICAN ASSOCIATION OF PARK SUPERINTENDENTS. Annual meeting. Detroit, Mich. Secretary, Emmet P. Griffin, Superintendent of Park, East St. Louis, Ill.

Sept. 13-16—NEW ENGLAND WATER WORKS ASSOCIATION. 39th annual convention. Bridgeport, Conn. Secretary, Frank J. Gifford, 715 Treont Temple, Boston, Mass.

Sept. 28 (10 days)—NEW YORK ELECTRICAL EXPOSITION. Seventy-first Regiment Armory, New York City.

Oct. 11-14—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual Convention, Atlanta, Ga. Hotel Anstey. Secretary, James J. Mulcahey, Municipal Building, Denver, Colo.

Oct. 24-28—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention. Southern Hotel, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Oct. 31-Nov. 5—NEW ENGLAND ASSOCIATION OF COMMERCIAL ENGINEERS. Power show in connection with INTERNATIONAL TEXTILE EXPOSITION. Mechanics' Building, Boston, Mass. Secretary, James F. Morgan, Devonshire st., Boston.

Nov. 14-18—AMERICAN PUBLIC HEALTH ASSOCIATION. Annual meeting. New York City.

LOUISIANA ENGINEERING SOCIETY

A regular meeting of the Louisiana Engineering Society was held June 13, under the auspices of the Louisiana Section of American Military Engineers. The subject for discussion was "The Army Engineer—A Rough and Ready Contractor."

An ordinance has been passed by the Constitutional Convention and will become a part of the Constitution of the State providing for a State Board of Health to be composed of a president and eight members, five of whom shall be from the medical profession and three from such callings as the Legislature may designate. It is becoming more and more generally recognized that the Engineer is, by training and experience, particularly fitted to solve many of the problems, and to direct many of the activities of modern health work, particularly those phases which deal with community sanitation and control of insect-borne diseases, as is evidenced by the fact that the Legislature of a number of States are requiring the appointment of Engineers as members of such Boards.

It was resolved by the Louisiana Engineering Society that it heartily favors the appointment of an engineer fitted by training and practice, to membership on the State Board of Health.

It was further resolved that the Society gives its unqualified endorsement to having a qualified Engineer appointed as a member of the State Board of Health, and expressly requests the Legislature at its next meeting to provide for such appointment.

PERSONALS

W. J. Young, chief engineer and general superintendent for the Alpha Portland Cement Co., of Easton, Pa., has resigned to accept a position as chief engineer for the Standard Lime & Stone Co. and the Washington Lime Co., of Baltimore, Md., both of which companies are controlled by the same interests.

Briggs, B. A., has been appointed superintendent of streets of Colorado Springs, Colo.

Higgins, Lafayette, has resigned as sanitary engineer of the Iowa State Board of Health.

Hood, William, chief engineer of the Southern Pacific Company, on May 2, retired from service after 54 years of railroad building with that company.

Karrick, James V., is now bridge designer with the Kentucky Highway Commission at Frankfort, Ky.

Myers, Clarence B., formerly with the Pennsylvania State Highway Department, has been appointed assistant engineer of the Philadelphia Bureau of Highways.

Shulde, H. G., has been appointed district engineer of the Pennsylvania State Highway Department, with headquarters at Bedford, Pa.

Smithley, Charles, has been appointed county engineer of Geary county, Kan.

Corwin, J. O., Jr., has been appointed engineer of Travis county, Texas.

Harvey, Bernard C., has been appointed city engineer of Rockford, Ill.

Catlett, George F., has been appointed principal assistant engineer of the Bureau of Engineering, North Carolina State Board of Health, in which capacity he will have charge of the water supply division of this bureau.

McCalman, D. S., has resigned as state highway superintendent of Wyoming.

Schade, Frank P., has been appointed city engineer of Cudahy, Wis.

Lanctot, Theodore, formerly assistant engineer in the public works department, Montreal, has been appointed city engineer of Hull, Que.

Ellerbrook, Carlos E., formerly highway engineer and inspector, Michigan State Highway Department, is now with the Iowa State Highway Commission as highway engineer.

Elliott, Edward G., is now county road engineer of Randolph county, West Virginia.

Rogers, C. J., formerly assistant county engineer of Jefferson county, Ala., has been appointed county engineer.

Chalmers, G. H., of Sudbury, Ont., has been appointed resident engineer for the construction of extensions to the water works system of St. Thomas, Ont., which work includes the construction of a concrete dam and reservoir in Kettle Creek valley.

Martin, D. K., and McRoy, W. W., have been appointed members of the Texas State Highway Commission, and Hubbard, R. M., has been reappointed chairman of the same commission.

Coleman, Dwight B., has resigned as county superintendent of highways of Cortland county, New York, and has been succeeded by William J. Dwyer.

White, G. S., was recently appointed city engineer of Fort Morgan, Colo.

Wade, G. R., has resigned as county engineer of Imperial county, Cal.

Null, G. W., has been appointed office engineer in Division 3 of the California Highway Commission to succeed C. F. Henitze, who is now assistant division engineer to Mr. Winslow.

O'Brien, J. J., was appointed superintendent of highways of Pittsfield, Mass., to succeed the late William J. Mahan.

Livermore, Herbert, has been appointed street commissioner of Johnson City, Tenn.

Galvin, John F., of Richmond, Cal., has been appointed secretary of the California State Highway Commission.

Baier, Nathan H., has resigned from the division of sanitary engineering, New York State Department of Health, to become operator and chemist with the new water purification plant at West Palm Beach, Fla.

Hargis, A. B., has been appointed city engineer and superintendent of water works of Jellico, Tenn.

Ballew, Ralph D., has been appointed manager of Grand Rapids, Mich.

Talbert, C. M., has resigned as director of streets and sewers of St. Louis, after about twelve years of service in this position, which is to be filled by C. H. Fisk, formerly assistant sewer commissioner of St. Louis.

Daggett, Frederick W., superintendent of the Trenton, N. J., filtration plant, died on May 10 in Trenton.

Page, Phineas, Jr., has resigned as highway superintendent of Niskayuna, N. Y., and Charles T. Male will fill his position.

Tong, B. H., has been appointed superintendent of highways of Emmons county, N. D.

Slopansky, W. M., has been elected city manager of Belleville, Kan.

Sefton, F. W., assistant city manager of Wichita, Kan., has been appointed city manager of Salina, Kan.

Caton, J. E., has been appointed city manager of Eldorado, Kan., to succeed Bert C. Wells, who recently resigned to assume a similar position at Atchison.

Rich, R. J., has resigned as county surveyor of St. Louis county, Minn., to become district engineer. His former position will be filled by H. T. Hare.

New Appliances

Describing New Machinery, Apparatus, Materials and Methods and Recent Interesting Installations

UTILITOR ROAD MAINTAINER

This machine, manufactured by the Midwest Engine Co., is a small, low-priced, self-conveying machine with independent power that can be economically and continuously used not only for efficient maintence operations, but can also be used as a small tractor or truck.

The fundamental purpose of the machine is to drag up the gutters so that the water will run out of the road bed, fill up the ruts, and not make the crown high enough for the water to run too fast. The machine is of simple, sturdy construction, easily operated by a boy of 16 and is so economical that it can be kept constantly at work on bad roads, improving them in direct ratio to the amount of service it does.

The machine has an 8-foot double blade drag and power to make small cuts with it. It is also equipped with a greater mileage efficiency than that of 3 or 4 horses.

The maintainer is provided with throttle controlled by a variable steam governor, which enables the operator to select the speed best suited to the conditions of the road and soil and to maintain it continuously without farther attention. When its power is not used for pulling the drag it may be utilized for tractor or truck service and can haul miscellaneous freight or can even pull a trailer better than a team of horses.

The continued use of the maintainer on a large percentage of the roads of the United States would keep them in good condition for their ordinary traffic and would prevent the necessity of frequent dragging, the cost of which would be more than paid by the economy of gravel or of broken stone. The expense of operation is so small that in one case a mile of almost impassable road was put into good condition by a maintainer, working 6 hours at a total expense of $5.

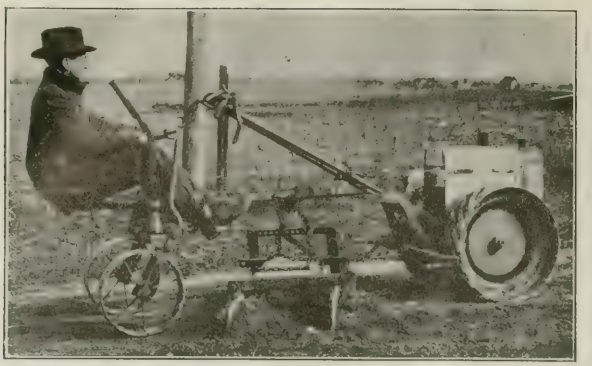
The results of applying the utilitor maintainer to a badly rutted earth road is shown in the accompanying group of

ROAD BEFORE OPERATING UTILITOR MAINTAINER

ROAD AFTER OPERATING MAINTAINER ONE HOUR

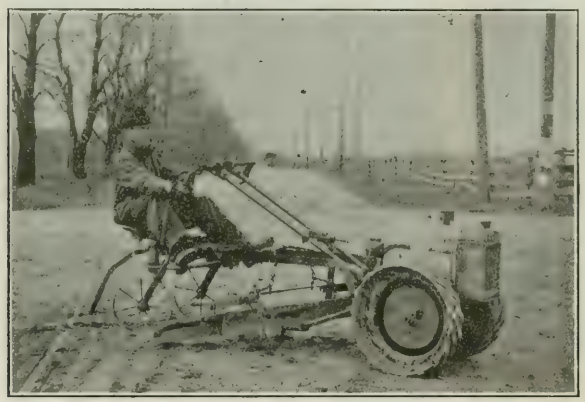
ROAD AFTER OPERATING MAINTAINER TWO HOURS

ROAD AFTER OPERATING MAINTAINER THREE HOURS



ROAD MAINTAINER MAKING LIGHT CUT WITH DOUBLE BLADE DRAG

pictures that graphically present the appearance of the surface before the maintainer commenced operations and at successive intervals showing the results of 1, 2 and 3 hours' continuous work of the maintainer that gradually eliminated the ruts, smoothed the surface and finally provided a uniform regular surface showing only a few superficial marks and adapted for traffic over the entire width instead of in the deep ruts where it was at first confined. Equal or better results can be obtained on a very large mileage of rural and semi-rural roads where at present dragging is insufficient and intermittent, but might be made continuous, profitable, and effective, by the use of a single machine that would be able to patrol a long distance and easily keep the road in good repair after such conditions had once been attained.



ROAD MAINTAINER OPERATING OBLIQUE BLADE SCRAPER

STRENUOUS MACHINE GRADING

On a 9-mile section of drainage ditch recently constructed in Norman county, Minnesota, 106,000 yards of earth excavated by a ditching machine was in 9 days leveled and graded into a 20-foot roadway by a 10-ton Holt caterpillar tractor pulling a Stockland Giant grader and operating under very great difficulties where the machine had to surmount deep inclines and execute heavy work that was considered a record performance for grade racing.

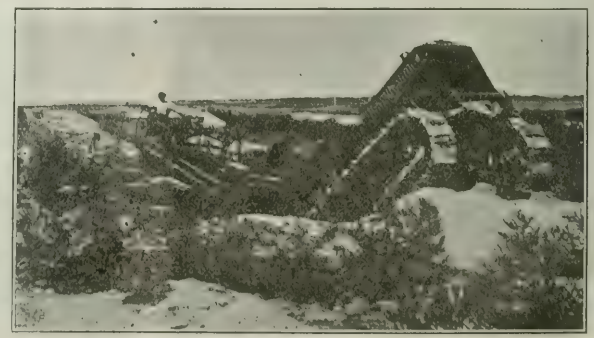
SULLIVAN PORTABLE MINE CAR AIR COMPRESSORS

The Sullivan Machinery Company manufactures the motor driven WK-26 portable air compressor mounted on a special truck that is described in bulletin 76-A. It is used chiefly underground to provide a convenient means for converting electricity into air power for the operation of rotator hammer drills, cement guns and other appliances, air drills in remote tunnel working, or pneumatic tools on steel construction, for street railway repair work, for paint sprays or for other work where a little air is required at widely separated points and for relatively brief periods. They can be placed wherever rails can be laid or where hard road is provided, and the operation of the machine requires simply its connection with electric wires and turning the switch. It is a single stage, horizontal compressor operated by gear and pinion from a motor and is of the center crank pattern with all moving parts enclosed in a dust-tight housing and provided with an automatic splash oiling system. The air cylinder is provided with automatic wafer inlet and discharge valves and is jacketed with a water cooling hopper. The fly wheel, of ample diameter, is driven by an inside gear engaging the small pinion on the shaft, which promotes smooth-running.

SMITH NON-TILTING MIXER

The Smith non-tilting mixers, described in bulletin 455-A and manufactured by the T. L. Smith Manufacturing Co., have wide mixing buckets that pick up the material, pour it into the center of the drum, whence it spreads out and is again picked up and returned to the center, keeping the concrete away from the sides of the drum and eliminating splashing and spilling. A full batch can be discharged in 8 to 10 seconds.

The boiler plate drum is continually kept clean and usually lasts six years or more and is provided with a distinctive single, central gearing containing both roller tracks. It is driven by a cross-shaft and spur pinion and fitted with an automatic measuring water tank and a gated batch hopper, a standard feed chute or a pivoted power loader as required. It can be mounted on trucks with a steam engine or an engine and boiler or an electric motor, or it can be driven by a gasoline engine.



TRACTOR AND GRADER LEVELING 20-FOOT ROADWAY ONE MILE PER DAY

Advance Contract News

ADVANCE INFORMATION **ITEMIZED PRICES**

To be of value this matter must be printed in the number immediately following its receipt, which makes it impossible for us to verify it all. Our sources of information are believed to be reliable, but we cannot guarantee the correctness of all items. Parties in charge of proposed work are requested to send us information concerning it as early as possible; also correction of any errors discovered.

BIDS ASKED FOR

STREETS AND ROADS

Ala., Dadeville July 6
For grading, draining and surfacing Alexander City-Jackson Gap road.—W. S. Keller, state hwy. engr., Montgomery.

Fla., Ocala 7.30 p. m., June 28
For pavements.—Geo. F. Young, city engr.

Ia., Boone July 20
For new work and reconstruction of paving.—C. L. Ehrhart, city engr.

Ia., Davenport 2 p. m., July 5
For improving various sts.—S. B. Murray, chn., Bd. Pub. Wks.

Ill., Springfield 10 a. m., June 28
For road work.—Clifford Older, ch. hwy. engr., Dept. Pub. Wks. & Bldgs.

Ill., Centralia 4 p. m., July 12
For pavement in "Melrose Paving District."—City

Ind., English 2.30 p. m., July 5
For John Spears et al. and Eli H. Stroud rds.—A. N. Babbitt, Craford co. aud.

Ind., Madison 1 p. m., July 6
For Peter Pelsor et al. Wm. Dow et al. and Grant Brittenback et al. rds.—Chas. S. Dibler, Jefferson co. aud.

Ind., Princeton 11 a. m., July 6
For Mark Armstrong et al. and D. A. Dill et al. rds.—Alfred M. Johnson, Gibson co. aud.

Ind., Shelbyville 10 a. m., July 6
For Elmer E. Barton, Orville Vernon, Frank Rohm, Iley Tyner and S. S. Montgomery rds.—Walter W. Leslie, Shelby co. aud.

Ind., Beech Grove 8 p. m., June 28
For improving sidewalks.—Verle Pierson, town clerk.

Ind., Danville 10 a. m., July 5
For construction of Marion Bailey et al. Hwy. and John Flinn et al. Hwy.—Comrs. Hendricks Co.

Ind., Franklin 2 p. m., July 4
For the Barnes and Kelch rds.—John C. Gregg, Johnson Co. Aud.

Ind., Hammond 2 p. m., June 29
For cement sidewalks.—Bd. Public Wks.

Ind., Knox noon, July 5
For J. J. Cannon and Chas. Petty rds.—Henry A. Smith, Starke co. aud.

Ind., Columbia City 1.30 p. m., July 6
For Goss-Lehman road.—Walter K. Burwell, Whitley Co. Aud.

Ind., Goshen 1 p. m., July 6
For B & O county line and Shaum rds.—Chas. A. Croop, Elkhart Co. Aud.

Ind., Jeffersonville 10 a. m., July 5
For Ed. Kern rd.—Thos. L. Stoner, Clark county aud.

Ind., Rochester 10 a. m., July 5
For Jno. W. Miller rd.—Jno. L. McClung, Fulton county aud.

Ind., Sullivan Co. noon, July 5
For three gravel and one rock road.—Frank M. Daniels, co. aud

Ind., Versailles 1 p. m., July 5
For Henry H. Gookins et al., Bernard Keen et al. and George Grossman et al. rds.—W. D. Robinson, Ripley co. aud.

Ind., Kokomo noon, July 6
For Samuel Lindley rd.—Orville O. Butcher, Howard co. aud.

Ind., Porter Co. 2 p. m., July 5
For John Runyon et al., Wm. Henry et al. and Aaron Earnard et al. rds.—E. H. Kruse, co. aud.

Ind., Winamac noon, July 5
For Wm. S. Vollmer rd.—J. C. Howe, Pulaski Co. aud.

Ind., Vernon 2 p. m., July 5
For Thos. Woods and Henry Burgmeier rds.—Everett Bemish, Jennings co. aud.

Md., Baltimore 11 a. m., June 29
For grading and paving.—R. Keith Compton, chn., Paving Com.

Mich., Charlotte 2 p. m., June 28
For State Trunk Line rd. No. 29 2, Section F.—Frank F. Rogers, state hwy. comr.

Minn., Albert Lea 2.30 p. m., July 12
For state aid job.—Fred Tavis, co. aud.

Minn., Gaylord 1 p. m., July 12
For state roads.—Fred Hoppenstedt, co. aud.

Minn., St. Paul 10.30 a. m., July 5
For grading, paving and otherwise improving various streets and for material for this work.—H. W. Austin, pur. agt.

Miss., Tupelo July 5
For constructing link of Nettleton-Cardsville road and link of Shannon-Piney Grove road.—J. M. Witt, clk., Lee County Supvrs.

Mo., Kansas City 10 a. m., July 1
For road work.—Leo E. Koehler, co. surveyor.

N. C., Washington 2 p. m., July 6
For paving Williamston rd.—Gilbert C. White, engr., Durham.

Neb., Spaulding July 2
For paving, curbing and guttering.—Prince & Nixon Eng. Co., Peters Trust Bldg., Omaha.

N. J., Belvidere 11 a. m., July 6
For highway construction.—Morris S. Faust, clk., Board Chosen Freeholders.

N. J., Plainfield 7.30 p. m., July 5
For paving.—Alexander W. Vars, city engr.

N. J., Salem 1.15 p. m., June 28
For highway construction.—Ervin G. Ochs, clk., Bd. Chosen Freeholders, Salem Co.

N. Y., Bronx 10.30 a. m., June 28
For regulating, repaving, etc.—Henry Bruckner, boro pres.

N. Y., Manhattan 2.30 p. m., June 30
For paving and repaving.—Francis D. Gallatin, pres., Park Board, Dept. Pks.

N. Y., Richmond noon, June 29
For sidewalks.—Calvin D. Van Name, boro president.

N. Y., Plattsburg July 8
For street and road work.—Bd. Public Works.

N. Y., Albany noon, July 6
For improvement and reconstruction of highways in various counties.—Herbert S. Sisson, comr. hwys.

O., New Philadelphia July 11
For grading and cutting Kuntz rd.—County auditor Baker

Pa., Somerset 2 p. m., July 5
For grading, paving and curbing East Catharine st.—C. E. Pile, secy., Town Council.

Tex., Anahuac June 28
For grading and surfacing.—H. J. Wolder, engr., Orchard.

Tex., Bastrop July 1
For grading and surfacing.—D. M. Pace, engr.

Tex., Fort Worth June 30
For [illegible] R. V. Clark, chgr., Court House.

Wash., Aberdeen July 1
For clearing, grading, draining and paving [illegible] hwy. Sixth Ward.

Wis., Shawano 7.30 p. m., July 5
For paving D. E. Wescott et al. clk.

Wis., Green Bay 11 a. m., June 29
For grading and draining Pendigo-Marinette road.—Wis. Hwy. Com.

SEWERAGE AND SANITATION

Fla., Jacksonville 2.30 p. m., July 1
For constructing storm sewer.—John S. Bond, chn. City Com.

Ia., Des Moines 9 a. m., June 31
For sewer connections on W. 5th. st.—A. E. M. Glothen, city clk.

Ia., Creston July 12
For sanitary and storm sewers.—P. K. DeVoe, city engr.

Ill., Wausonda 7 p. m., June 28
For sewers and sewage disposal plant.—E. H. Dahms, secy., Board Local Imp.

Ind., Indianapolis 10 a. m., July 8
For construction of local sewer.—Ed Pub. Wks.

Ind., Knightstown 8 p. m., July 5
For constructing local sewer.—Robt. M. Parker, town clk.

Ind., Indianapolis 10 a. m., July 6
For sewage disposal plant.—Ed Sanitary Comrs.

Mass., Boston noon, June 30
For sewerage works in Chilton road, West Roxbury.—Thos. F. Sullivan, com.

N. J., Newark 10.15 a. m., June 29
For pipe, manholes, basins, etc.—T. L. Raymond, dir., Dept. Sts. & Pub. Improvements.

N. Y., Boro Bronx 10.30 a. m., June 28
For sewer.—Henry Bruckner, boro pres.

N. Y., Buffalo 11 a. m., July 1
For sewers in certain streets.—Arthur W. Kreinheder, comr. pub. wks.

N. Y., Brooklyn 11 a. m., June 29
For sewers in various streets.—Edw. Rielgelmann, boro pres.

Wis., Cumberland July 5
For sanitary sewerage system and treatment plant.—Ed Pub. Wks.

WATER SUPPLY

Ga., Elberton 3 p. m., July 12
For water works systems.—Jno. T. Dennis, mayor

Ia., Des Moines 9 a. m., June 31
For water connections in West 5th st.—A. E. Mel'othen, city clk.

Minn., Canby 8 p. m., June 29
For construction of tank.—Marvin Ostenson, city clk.

N. Y., Attica 6 p. m., July 11
For water works improvements.—Bd. Trustees.

N. Y., Manhattan 10.30 a. m., July 1
For hydrant parts.—Board Purchase, Grover A. Whalen, chn.

O., Toledo noon, July 6
For centrifugal pumping units, switch board, piping, valves, Venturi meter and other accessories.—C. A. Benedict, dir. Pub. Service.

Okla., Duncan 7.30 p. m., June 29
For reservoir.—Robert Frensley, city clk.

S. D., Kimball 8 p. m., July 12
For water mains.—C. H. Coxe, city aud.

BRIDGES

Conn., Hartford 2 p. m., June 28
For bridge construction at Mystic river.—C. J. Bennett, state hwy. comr.

Ga., Covington July 1
For rebuilding bridge at Island Shoals, South river.—Co. Comrs., Newton and Henry counties; Dan Upshaw, Covington.

Ind., Washington 2 p. m., July 5
For constructing various bridges.—Daniel I. Myers, Daviess co. aud.

Mich., Detroit 10 a. m., July 8
For bridge across River Rouge.—Bd. Co. Rd. Comrs.

Mo., Kansas City 10 a. m., July 1
For bridge.—Co. Surv., Jackson Co.

N. J., Trenton 11 a. m., July 6
For repairs to bridge over Matawan creek, and other bridge work.—A. Lee Grover, ch. clk., State Hwy. Com.

O., Orrville 1 p. m., July 5
For constructing Horn bridge.—Fred E. Faber, clk., Comrs. Wayne Co.

O., Tiffin July 6
For bridge in Bloom twp.—J. H. Morcher, co. aud.

S. D., Tacoma 2 p. m., June 30
For construction of bridge across White river—Arthur Sypherd, Co. Aud.

Wis., Wisconsin Rapids July 8
For Wisconsin Rapids bridge.—State Hwy. Com.

W. Va., Clarksburg July 5
For constructing bridges.—C. N. Parrish, clk., Comrs. Harrison Co.

LIGHTING AND POWER

Neb., Lincoln 10 a. m., July 15
For construction of water and light plant.—Theo. H. Berg, city clk.

N. D., Grand Forks 10 a. m., July 5
For addition to power plant.—Chas. Liessman, secy., Board Administration of State.

N. Y., New York noon, Aug. 14
For Morwell power scheme.—Bur. For. and Domestic Commerce, U. S. Dept. Commerce, 734 Customs House, N. Y. C.

O., Wapakoneta noon, July 12
For power plant and equipment.—R. H. Rogers, dir. public service.

FIRE EQUIPMENT

N. D., Wahpeton 8 p. m., July 5
For triple combination fire truck with complete equipment.—S. H. Murray, city aud.

N. J., South Orange 7 p. m., July 5
For hook and ladder.—Edward R. Arcularius, twp. clk.

O., Toledo noon, June 28
For fire hose and couplings.—Jos. J. Judge, comr. purchases and supplies.

Wash., Puget Sound July 6
For fire alarm system addition.—Bur. Yards & Docks, Navy Dept.

MISCELLANEOUS

Fla., Jacksonville 10.30 a. m., June 28
For dredging in St. Johns river.—J. S. Bond, chn., City Com.

Fla., Miami July 20
For piers at municipal docks.—C. W. Murray, city engr.

Ind., Brownstown 2 p. m., July 9
For constructing drain.—Elias B. Douglass, supt. construction, Jackson Circuit Court.

Minn., Redwood Falls June 28
For Ditch 72.—F. H. Anthony, engr., structing Quartermaster, Philadelphia.

Minn., Ada 11 a. m., June 28
For spillway on main branch judicial ditch 56, Norman and Clay twps.—A. C. Houglum, Clay co. aud.; D. E. Fulton, Norman co. aud.

Mont., Savage 2 p. m., July 15
For canal extension, laterals, etc.—U. S. Reclamatioin Service.

Mont., Great Falls 2 p. m., July 10
For canals and laterals on lower Yellowstone project.—Geo. Stanford, mgr., Sun River Project, Reclamation Service, Savage, Mont.

N. Y., Manhattan noon, June 30
For new bulkhead wall at Battery pl., North river.—Murray Hulbert, comr. of docks.

N. Y., Manhattan 8 p. m., July 12
For shafts for vehicular tunnel under Hudson river.—N. Y. State Bridge & Tunnel Com., & N. J. Interstate Bridge & Tunnel Com., Room 617, Hall of Records.

O., Cincinnati noon, June 29
For cement.—Ernst Von Bargen, city pur. agt.

Work Contemplated

STREETS AND ROADS

Ala., Montgomery—State Hwy. Dept. estimates proposed projects in ten counties to cost $2,000,000.

Ala., Tuscaloosa—State will soon advertise for bids for construction of Byler road, also bids will be asked for bridge across Warrior river, $500,000.

Ala., Tuscaloosa—Kaul Lumber Co. have completed survey for its logging road.

Ala., Birmingham—Ordinance passed to provide certain improvements on 24th st. N. A. Barrett, pres. of com.

Alaska, Juneau—Up to this time there has been allotted for road work in the First Division by Bureau of Public rds., $110,000, state R. J. Somers, secy., Ter. Rd. Comsn. The most important allotment is for the Glacier Hwy. project, connecting Juneau, Mendenhall Glacier and Auk Lake at a cost of about $54,836.

Ark., Little Rock—Federal Aid for 5 road districts in Arkansas approved, aggregating $238,550.

Ark., Morrilton—Paving of streets to cost $125,000, will begin in September.

Cal., Sacramento—New joint counties highway bill signed for good roads throughout Sacramento Valley. New rd. proposed for construction.

Cal., San Francisco—Van Ness ave. will be extended.

Cal., San Francisco—Ordinance passed to improve streets.

Cal., Quincy—Survey will begin at once to ascertain cost of road between Indian Falls & Twain Plumas Co.

Colo., Colorado Springs—City plans paving of various street intersections on Cascade ave., at cost of $30,000. W. L. Hoffeditz, city engr.

Conn., Manchester—Bd. of selectmen will ask for $10,000 additional appropriation for hwys.

Conn., Hatford—$35,000 appropriation approved for paving of Washington st.

D. C., Washington—Road construction projects in Sumter and Washington counties, involving expenditure of $475,588, forwarded by Federal Bureau of Public Roads.

Fla., Tampa—Board Co. Comrs. issued orders to have plans, etc., made for $160,000 system of roads in Gulf shore Special Road & Bridge District.

Fla., Orange Co.—Citizens propose to construct roads, $2,300,000. Bond election for July 10, $2,500,000.

Fla., Emeralde—Contemplating road construction from Lisbon to Emeraldo, Orange ave. also to be extended.

Fla., St. Petersburg—It is proposed to expend $1,000,000 on road construction and improvement.

Fla., Palatka—Forty blocks of new street paving contemplated this summer.

Ga., Rome—County board decides to take over about a mile of new Lindale Road for completion.

Ga., Lyerly—Meeting held to urge and devise plans for building connecting highway from Summerville to Menlo and Fort Payne Mentone Hwy. in Ala., $60,000 cost.

Ia., Davenport—City plans to excavate, curb and repave Marquette st., $2,620.

Ia. Dubuque—Resolution passed to improve Bluff st., also recommendation for portions of sidewalks to be constr. on Cox st.

Ia., Marshalltown—Council adopted resolutioins calling for 7 blocks new paving and reconstruction of two and a half blocks of old paving.

Ia., Davenport—Official notice of intention to pave various streets.

Ia., Davenport—Rd. bonds $480,000 to be placed on market very soon

Ida., Boise—County plans to grade 100 miles of roads this summer.

Ida., Pocatello—D. P. Olson, director of hwys. has outlined a road-building program for the coming year of about $120,000.

Ida., Wallace—Bids will be opened at Wallace for 5 1-2 miles of road construction over new grade to cross divide between Wallace and Montana side. Expected road will cost approximately $50,000.

Ida., Boise—Federal appropriation of $100,000 will be asked for Utah-Idaho-Yellowstone Hwy.

Ida., Boise—Bannock county plans for coming year road projects totaling $120,000 in cost, states D. P. Olsen, dir. of hwys.

Ill., Decatur—Plans in progress for construction of 6 miles sidewalks, also paving, $390,000 for road work and bridges.

Ill., Decatur—City council intends to pave block in West Forest ave.

Ill. Danville—Plans to expend $25,000 to purchase equipment for road building.

Ill., Decatur—State Aid Road Comn. considers construction of hard roads in Macon Co.

Ill., Davenport—Plans prepared for re-location of Davenport-Princeton rd., $32,000.

Ill., Silvis—Local Board considers paving 5 streets.

Ill., Rock Island—City Comrs. considers paving 14 avenues with brick at cost of $32,144.

Ind., Columbia City—City Council approved road to north and main street, 6 miles.

Ind., Indianapolis—Resolutions passed to re-advertise bids on paving, curbing and boulevarding certain sts.

Ind., Indianapolis—Board Pub. Wks. authorizes resurfacing of 5 sts.

Ind., Delaware Co.—Treasurer Earle H. Swain will offer at Muncie, on June 27, a road bond issue of $69,200 bearing 5 per cent.

Ind., Marshall Co.—Treasurer Charles F. Cooper will offer at Plymouth, on June 28, a road bond issue of $23,190, bearing 5 per cent.

Ind., Spencer Co.—Treasurer Frank M. Harter will offer at Rockport on July 5, a road bond issue of $9,300 bearing 5 per cent.

Ind., Allen Co.—Bond issue of $90,000 purchased by Lincoln Trust Co., Fort Wayne.

Ind., Tipton Co.—Bids soon called for more road trucks.

Ind., Indiana—Plans for resurfacing of street ordered.

Kans., Kansas City—City Planning Comn. consider widening of Holmes st., also widening of various sts.

Kans., Leavenworth—Fed. aid amounting to $20,000 was granted by State Hwy Com. to county to construct 2 miles hard surface road.

Kans., Topeka—State Hwy. Comn. has $190,000 in Federal Aid to distribute to various counties for road construction.

Mass., Boston—City finance committee has awarded highway loan of $60,000 to Merril Oldham & Co., Boston.

Mass., Boston—Board of Street Comrs. give notice of improvement of three rds. consisting of of layout and construction, as a highway.

Mich., Northville—Range of bids on gravel highway were $9,000 to $13,000 per mile. Contracts awarded later.

Mich., Charlotte—It isi proposed to rebuild Federal Road in Eaton co., 7 miles in Bellevue and Walton twps.

Mich., Owosso—City Comn. approved bond issue for paving and curbing, $45,000.

Minn., St. Paul—Additional improvements planned for Trunk hwy., $1,750,000. Early call for bids expected.

Minn., Warrond—Grading and gravel surfacing on 12-mile stretch on State Trunk Hwy. No. 11 between Warroad & Roosevelt ordered by Hwy. Comr. Babcock. Estimated at about $60,000.

Minn., St. Paul—Cook Co. receives $15,000 appropriation for highway imp.

Minn., St. Paul—$15,000 appropriated by State Board of Relief to construct rd. from present highway to Grand Marias.

Miss., Hattiesburg—City will pave Adeline st. Address W. E. Estes, clk.

Mo., Kansas City—Board Pub. Wks. passes resolution to pave widened portions of Troost ave.

Mo., Kansas City—Bd. Pub. Works passes resolution for paving and widening portions of Troost ave.

Mo., Kansas City—Park Board approved plans for paving driveway at entrance.

Mo., Kansas City—Approximately 6,000 miles state roads to be improved.

Mont., Missoula—Ordinance No. 490-A passed creating special improvt. district No 45, comprising grading of Blaine st., constructing concrete sidewalks and curbs, etc. Protests to be heard later.

N. C., Raleigh—State High Comsn. has decided upon the erection of two rock crushing plants at an approximate cost of $200,000. The Commission also ordered the immediate construction of the Charlotte - to - Statesville - Davidson rd. of 45 miles.

N. C., Charlotte—Plans being made to eliminate grade crossings in Mecklenburg Co.

N. C., Wilmington—Co. Comrs. receive petition to construct new road to connect Scotts Hill and Middlesound with Wrightsville.

N. C., Hickory—Co. Comrs. plan to hard surface Central Highway. State will appropriate $125,000

N. C., Hendersonville—County purchases $15,000 worth of road machinery for contemplated road improvement.

N. C., Mooresville—The North Carolina Highway Commission authorized the construction of the Charlotte-Statesville Highway. Estimated cost approximately $1,000,000.

Neb., Lincoln—Ordinance passed to grade 23 sections of sts.

Neb., Valentine—K. C. Madden, Prospect, engr. for Valentine Sparks state road project receives orders to add 4,000 ft. to highway surfacing.

N. H., Manchester—City will consider the issuance of bonds to amount of $150,000 for highways and $50,000 for sewers.

N. J., New Brunswick—Middlesex Co. has sold road improvement bonds of $262,000. Will proceed with Mile run culvert and pave West ave.

N. J., Trenton—An appropriation of $7,000 will be called to pave Sauhican drive.

N. J., Hillside—Ordinance passed to open Westminster ave. as public street.

N. J., Rahway—City Comrs. pass ordinance for laying concrete pavement and curb in Central ave. at cost of $14,866.

N. J., Ocean City—Board Public Wks. orders advertisement for bids on bldg. portion of alley.

N. J., Union Twp—Ordinances passed to construct sidewalks on 3 streets.

N. J., Newark—East Orange Plan body proposes new highway.

N. J., Newark—Ordinance passed authorizing issuance of $250,000 public improvement bonds.

N. J., Rochelle Park—Board orders advertising for bids for resurfacing Sheridan ave.

N. J., Atlantic City—$150,000 sought for road construction contemplated.

N. J., Atlantic City—Ordinances passed to issue $13,000 bonds for extension of Oriental ave.

N. J., Burlington—Work will soon begin on improving High st.

N. J., Hamilton Co.—Ordinance passed to construct curbs and sidewalks on 12 sts W. C. Rockhill Hart, twp. clk.

N. Y., Fairport—Citizens authorize paving of West ave., $40,000.

N. Y., Williamsville—City will improve two streets at cost of $39,000.

N. Y., Boro Richmond—Board of Public Works plan to grade and pave Brighton ave.

N. Y., Boro Brooklyn—Resolution was passed to grade, curb and flag 12 sts.

N. Y., Boro Brooklyn—City plans to change grade of Van Sinderen st.

N. Y., Boro Queens—Local Board plan to grade, curb, flag and pave 80th st.

N. Y., Boro Bronx—Local Board plan to curb, flag, etc., six streets.

N. Y., Boro Bronx—Additional appropriation of $20,000 for repaving roadways in Parks.

N. Y., Boro Manhattan—Board Estimate and Apportionment decide to adjust street dimensions.

N. Y., Boro Queens—City Board of Estimate plan changing lines and grades various streets.

N. Y., Boro Richmond—Hearing called for changing grades of 2 streets.

N. Y., Boro Bronx—Plan adopted, passed to change lines and grades at approach to 215th st. Viaduct.

N. Y., Oswego—$100,000 assessment for secondary system of roads made. Plans for repairing of roads this year. Permanent work next year.

N. Y., Oswego—Construction work on proposed Normal School highway may be delayed until next year.

N. Y., Rochester—Ordinances passed to widen two streets at cost of $[illegible].

O., Ironton—Bid for improvement of 6 streets rejected. Will readvertise.

O., Akron—City council considers construction of North Hill viaduct.

O., Toledo—Resolution passed to improve Worthington st. by paving.

O., Toledo—Petition received for improvement of alley by grading.

O., Middletown—Resurfacing of Middletown pike with sheet asphalt. $131,500.

O., Warren—Contemplating Jones rd., 1 1-2 miles, draining, grading and bridging.

O., Warren—Bids called on $85,000 bonds until July 5, for improving of rds.

O., Tiffin—City plans to brick Circular st. and Melissa st. with macadam, conc. curb and gutter. South Jefferson st. and other streets to be improved.

O., Mt. Vernon—Four streets will be improved.

O., Jefferson—Five miles county rds. from Bushnell to Piermont twp.

O., Hamilton—Plans prepared for Mt. Pleasant Pike, $200,000. Frank Weaver, engr.

O., Bucyrus—Scott road to be improved, loose macadam $9,,000.

O., Pauilding—Curtis A. Woods, aud. of Pauilding Co., will received sealed proposals to July 1 for the sale of an issue of $208,000 of highway bonds.

O., Urbana—Salem twp. residents object to proposed improvement of State Road, $126,000 Fed. Aid for project.

O., Wellsville—City plans to pave Wells ave. paving block on conc. base.

O., Youngstown—Plans in progress for Coitsville twp. road improvement.

O., Liverpool—Various roads to be improved, contemplated.

O., Magnolia—Plans being prepared for new road. $60,000 bonds sold.

O., Niles—$75,000 bonds proposed for widening streets.

O., Hamilton—Middletown Pike to be improved, $148,000.

O., Cleveland—Marshall Farms Co. will purchase property one mile west of the corporatin line of Ashtabula Harbor. The property will be developed with an amusement park, a country club and an allotment, converting it into a summer home colony.

O., Toledo—Council Public Improvement committee will readvertise for bids for construction of the Grande Rounde highway project.

O., Findlay—City Council decided upon a street improvement program calling for an expenditure of more than $100,000.

O., Toledo—Council authorized a $125,000 bond issue to motorize a portion of the division of streets equipment, including that used in garbage collection.

Ore., Hood River—County votes $350,000 bonds to cover construction of county roads.

Ore., Portland—Mount Hood loop rd. will be cleared and graded this season for the 23 miles between Multnomah co. line and Zigzag. It is possible that part of it may even be macadamized this yr.

Ore., North Bend—One of the new improvements contemplated this summer is an auto truck road up Sixes river to Inman Minig Co.'s property, grading, estimated, $20,000.

Ore., Amity—The City Council passed a resolution of intention to improve Jel-

lison street, by grading and draining. W. R. Osborne, recorded.

Pa., Philadelphia—Municipal street cleaning is planned for this city.

Pa., Harrisburg—Construction of Carlisle to Boiling Springs road expected to be started in few weeks.

Pa., Blacklick—$50,000 bonds for road purposes carried at recent election.

Pa., Erie—No bids received in county road bond issue of $500,000.

Pa., Warren—Fourteen miles of improved highway to be submitted for bids very soon.

Pa., Harrisburg—State Hwy. Comn discuss the three roads to be made in Cumberland county.

Pa., Pittsburgh—Co. Comrs. approved $1,800,000 program for road improvement in Allegany county.

Pa., Philadelphia—Advertising for bids on second portion of big repaving program will begin soon.

Pa., Erie—County will soon advertise for bids on $500,000. Bond issue for paving and construction of roads.

S. C., Bennettsville—$180.000 bonds carried in recent election for improvement of roads.

S. C., Fort Mill—Citizens voted in favor of a bond issue of $75,000 for the purpose of constructing road imprvts.

S. D., Watertown—Bids will be asked soon for the paving of Maple st. and Third st., Northwest.

Tex., Harrisburg—City election June for bonds of $15,000 for street paving carried. $85,000 sewer also carried.

Tex. Chambers—$50,000 road district bond issue ordered July 2.

Tex., Lamb—$50,000 bond issue for road improvement carried.

Tex., Floyd—$100.000 bond issue defeated.

Tex., Houston—Sands & Hawley have been appointed City Engrs. of Breckenridge to superintend the expenditure of a bond issue of $900,000; $600,000 will be for permanent city pavements and $300,000 for a sewer disposal plant.

Tex., Texarkana—Contract for the remaining $300,000 of road work has not yet been awarded.

Tex., Ennis—This city will create a system of public parks commencing with a 15-acre tract 2 miles west of town. An athletic field will be built, a natatorium, tennis courts, and children's wading pools.

Va., Lynchburg—Council authorized appropriations of $50,000 for paving 5th st. from Main st. to Park ave.; $10,000 for conduits for electric wires under sidewalks in 5th st.

Wash., Okanogan—Local improvement district has been created and plans completed for laying out and concrete sidewalking nine blocks in the residence section.

Wash., Spokane—County treasurer reports whole of Spokane county $550,000 county road bonds, covering 1921 building program, sold.

Wash., Yakima—Co. Comrs. decide to close gap in inland Empire Hwy. bet. Buena and Granger. The county will spend $150,000 and the state $90,000 on the project.

Wash., Seattle—Ordinance passed to improve two streets and alleys. E. M. Street, clerk.

Wash., Ellensburg—$100,000 expenditure on Blewett Pass contemplated.

Wash., Missoula—New road planned penetrating valuable timber district.

Wash., Spokane—County Treasurer E. R. Innis reported recently that all of the $550,000 of Spokane County road bonds for this year's road program had been sold.

Wash., Spokane—Harry Baker, county engr., states $40,000 must be expended on Sunset Hwy. west of Spokane to eliminate several dangerous curves.

Wash., Seattle—Lake Hwy. construction contemplated, $200,000 to $290,000.

Wis., Hurley—Road bonds $29,500 sold to Chas. H. Coffin, Chicago.

Wyo., Laramie—The Rocky Mountain Highway Association was formed at Laramie, headed by P. C. Spencer, of Lander, Wyo., for a road to extend from Denver to the Yellowstone National Park, a distance of 563.7 miles.

Wyoming—Proposals received until July 6th for $1,800,000 Hwy. Bonds. A. D. Haskins, State Treas.

Ont., Windsor—By-laws totaling $90,000 were authorized here for the construction of sidewalks and $30,000 bonds were voted for a new police station at Park and Goyeau sts. It is also planned to erect a municipal asphalt plant in this city.

SEWERAGE AND SANITATION

Cal., Los Angeles—Plans are being prepared for constructing 5.17 mi. storm drainage system, large rein.-conc. drns., and vitr. pipe laterals from Madison ave. and Temple st. to point south of Pico st. About $2,000,000.

Cal., Los Angeles—Plans are being prepared for building 7.65 miles main line sewer in 23d st. from Hooper to Maple aves., also 44.95 mi. laterals and storm drains in West Jefferson st., etc. About $4,000,000. J. T. Griffin, City Hall Annex, engr

Cal., LaVeta—Town rejected bids building sewage disposal plant in Dist. 1, involving 12,420 ft. 6-12 in. vitr. brick pipe. Work will be readvertised. About $25,000. F. H. Brooks, town engr.

Conn., Westfield—City Council decides to construct sewers, $200,000.

Ia., Creston—City plans to build 4 mi. sanitary and storm sewers. About $50,000. P. K. DeVoe, city engr.

Ia., Dubuque—Resolutions passed to construct sanitary sewers in two sts.

Ill., Chicago—City intends to construct sewers in various streets.

Mass., New Bedford—City plans to extend sewerage systems in various sts. About $150,000. W. H. Rennington, city engr.

Mass., Ludlow—It has been decided to extend vitr. sewerage system. Cost between $25.000 and $30,000.

Minn., Gilbert—Bids will soon be opened for sewer construction, curbing and cement sidewalks. Est. cost, $90,000.

Minn., Stillwater—City having plans prepared constructing outlet sewer in Mulberry st. About $57,787.

Minn., Copper City—Election called to vote $10,000 bonds for construction of general system of sewers, June 27.

Mo., Independence—City voted $130,000 bonds and having plans prepared for 3 disposal plants and ejector stations.

Mo., Marceline—City plans constructing sewer system. Benham & Mullergren, consult. engrs., Kansas City, Mo.

N. J., Egg Harbor City—Resolution passed for sewerage plant.

N. J., Sayreville—Bond for sewer contract was fixed at $75,000 with an additional maintenance bond of $20,000 for six months after completion of work.

N. Y., Boro Richmond—Bd. of Estimate & Apportionment consider constr. of sewers.

N. Y., Boro Brooklyn—Local board passes resolution to construct sewers in various streets.

N. Y., Buffalo—City council intends to construct 18 in. tile sewer in 2 sts. and four and three ft. diameter sewer in Dartmouth ave.

N. Y., Rochester—Ordinance passed to construct sewer in Avon place.

N. Y., Oswego—Plans being prepared to construct sewers in 5 streets.

N. Y., Boro Queens—City plans sewer construction.

N. Y., Syracuse—Sewer extensions are contemplated. City clerk.

N. Y., New York City—Council contemplates system of garbage disposal.

O., Springfield—The city will build the Warder st. and Fostoria ave. sewers by direct labor. Edgar E. Parsons is city manager.

O., Marion—Sanitary sewer ordered to be constructed in Fair Grounds.

O., Salem—Sanitary sewers will be built in Green and Summit streets.

O., Sandusky—Property owners protest against proposed sewer.

O., Cleveland—The village of Rocky River, this county will make $200,000 in improvements this year including many sewers and the laying of water mains.

O., Toledo—A bond issue of $125,000 for motorizing the garbage collection equipment has been voted by the city council. The money will be used for the purchase of motor trucks and trailers.

O., New Philadelphia—At a cost of abt. $6.000 sanitary sewers are to be laid in Ray, Miller, Kelly and Wabash sts.

O., Painesville—A delegation from Willoughby, this county, has petitioned the county comrs. for the creation of a sewer and water district from Willoughby to the Lake.

O. Portsmouth—A storm and sanitary sewer will be constructed between Harrisonville and Lakeview aves. Probably 30 inches.

O., Elyria—Resolution adopted for sanitary sewers in Parkview court and Garvin ave.

O., Middletown—Bond issue of $3,839 authorized for sewers.

Okla., Comanche—City voted to issue $275,000 sewer, light and water bonds.

Okla., McAlester—City will improve and extend sewer system; construct two Imhoff tanks for disposal plant; cost, $50,000.

R. I., Cumberland—It is proposed to extend sewers in Chapel and Crescent sts. About $120,000. E. S. Nettleton, Bureau of Engineering, city engr.

S. C., Union—City will extend sewerage lines. The mayor

Tex., Rising Star—Sewer bonds to the amount of $30,000 voted. The mayor.

Tex., Greenville—Storm sewers, costing approximately $50,000, will be constructed in near future. The mayor.

Tex., Magnolia Park—It is planned to issue $500.000 bonds for sewer, water works and street improvements, etc.

Tex., Alto—At a recent election an issue of sewerage system bonds to the amount of $35,000 was authorized.

Wash., Spokane—The proposed North Side sewer in the northwest part of the city, estimated to cost $62,500, met with strenuous opposition when brought before the City Council. The work will be held up.

Wis., Bloomington—Plans will be made soon for construction of sewer system, for which a petition has been circulated. City clerk.

W. Va., Spencer—Town voted $40,000 bonds to build sanitary sewerage system.

Ont., Sault Ste. Marie—Council will call for bids in near future for proposed sanitary sewerage system. Estimated cost, $52,100.

Ont., Niagara Falls—City plans to build Muddy Run sewer. About $250,000 James Proctor & Redfern, 36 Toronto st., Toronto, engrs.

Ont., Brantford—Construction of sanitary sewer on Alonzo st. and a storm sewer on Arthur st. authorized. F. P. Adams, city engr.

Que., Montreal—City plans to build 3 3-4 miles brick sewer in Sherbrooke st. E. from Delormier ave., eastward. About $388,938. A. E Doucet, city mgr.

PITTSBURGH METER COMPANY

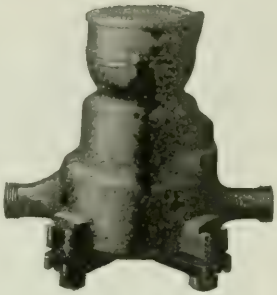
QUALIFIED BY MANY YEARS' EXPERIENCE IN METER BUILDING.~

"Arctic"—A frost-bottom meter for cold climates.

"Keystone"—An all-bronze meter for warm climates.

"Eureka"—A current meter for large and rapidly flowing volumes of water.

"Keystone Compound"—For services requiring close registration of both large and small flows.



OUR HIGHEST AIM—

is to supply, at a reasonable initial cost, a product that will register accurately and be economical to operate and maintain. Our ever-increasing business testifies to our success in that direction.

If you visited our exhibit at the American Water Works Convention, you are no doubt convinced of the superiority of our product. If you did not have an opportunity to inspect our meters there, we invite your investigation now.

May we not assist you in determining the type of meter best suited to your needs?

Meters For Measuring Water, Gas, Air, Oil, Gasoline and Other Fluids

General Office and Works, East Pittsburgh, Pa

SALES OFFICES

NEW YORK—50 Church St.
CHICAGO—5 S. Wabash Ave.
KANSAS CITY—Mutual Bldg.
COLUMBIA, S. C.—1433 Main St.
SEATTLE—Railway Exchange Bldg.
LOS ANGELES—Union Oil Bldg.

WATER SUPPLY

Colo., Siebert—City plans to sell $50,000 bonds to build waterworks system.

Conn., Hartford—Resolution passed for additional issue of bonds for work on water supply system, $200,000.

Fla., Miami—Miami Waterworks Co., having plans prepared for combined filtration and softener plant. About $500,000.

Fla., Milledgeville—It has been decided to issue water bonds to the amt. of $50,000.

Ga., Bibb City—City voted $15,000 water supply bonds. The mayor.

Ia., Eldora—City having plans prepared improving waterworks system. Burns & McDonnell, Interstate bldg., Kansas City, Mo., engrs.

Ia., Cedar Rapids—City plans to build 2 settling basins, douglas fir on cement piers. About $15,000.

Ia., Dubuque—City bond issue of $50,000 proposed for sale July 5 for water system improvement.

Ill., Bellwood—City plans to construct new waterworks system. About $167,000.

Ill., Flora—City having plans prepared extending waterworks and improving electric light and power plants. Work includes laying of water mains and adding 1 unit of power plant. About $40,000.

Kans., Council Grove—It is planned to improve water works system. Black & Veatch, Kansas City, Mo.

Md., Frederick—City will improve water supply; construct dam, concrete and stone construction, 22 ft. long, 6 ft above foundation. The mayor.

Mich., Grand Rapids—City Council will have survey made of west side water works.

Mich., St. Louis—City voted $15,000 bonds to build concrete reservoir. Plans being prepared. Burd & Giffels, civil engrs., Grand Rapids.

Miss., Meridian—City will install two filters at pumping station, increasing number of eight filters, with daily capacity of 4,000,000 gallons of water.

Mo., Kirksville—A propositiion to issue water bonds to the amount of $285,000 was submitted to the voters on June 21.

Mo., Haytl—Bonds to the amount of $30,000 will be sold for construction of water works system. Engineer not selected.

N. C., Asheville—It is planned to issue $25,000 bonds to extend water mains. B. M. Lee, city engr.

N. C. Charlotte—City plans to expend $200,000 for water plant improvement.

N. D., Fessenden—It was recently voted to issue $30,000 bonds for building water tower, pumping station and full distribution system.

N. Y., Wellsville—Water & Light Com. receives bids about July 8, installing 2 300 h.p. water tube boilers and 1,0000,000 gal. daily capacity rapid sand filter plant. Bonds for $65,000 were voted for project.

N. Y., North Tonawanda—City plans to build filtration plant. About $200,000.

N. Y., Syracuse—Bids will soon be called for construction of first six miles of new conduit to bring water from Skaneateles Lake to city. $750,000.

N. Y., Wellsville—Election held recently to decide upon proposals for improvements to water and light system, including million-gallon rapid sand filter plant and two 300 h. p. water tube boilers. E. J. Rowe, supt.

O., Youngstown—$5,000,000 bond issue proposed for belt line water supply, extension of mains and installing 10,000,000 gal. pump.

O., Elyria—The city council has passed an additional $360,000 bond issue for completing, enlarging and improving the Elyria water works system.

O., Springfield—The city comsn. has authorized a $100,000 bond issue for reinforcing the distributing system of the water works dept. Bids will shortly be invited.

O., Xenia—The authorities of Antioch col ege at Yellow Springs, this county, will construct a water works system on land recently donated to the college by George Little, manufacturer and banker of Xenia and a trustee of the college

O., Springfild—Installation of boilers at water works pumping station proposed, $150,000.

O., Dover—Bids rejected for water line in Park and Regent sts. and will readvertise.

O., Fostoria—State Dept. of Health may order improvement of water supply.

O., Barberton—Water mains will be laid in Orchard ave., Parker ave., and 5 more sts.

O., Springfield—This city will purchase new boilers for the water works station. George Cotter is the supt. of the waterworks dept.

O., Dover—The council has passed ordinances to proceed with the construction of a water line on 12th st. from Wooster ave. to Cross st. and in parts of Race and E. 12th sts.

Okla., Comanche—City voted bond issue of $275,000 for water, light and sewer systems.

Okla., Okmulgee—City having plans prepared improving waterworks system, including elevated reservoir, 15 mi. new mains and extensions to filters. Abt. $400,000.

Okla., Supply—Vote to be taken soon on bond issue of $20,000 for water wks. improvements. The mayor.

Ore., Cresswell—Election will be held July 18 to vote $18,000 bonds for impvts. to water system.

Ore., Brownsville—Brownsville is selling bonds to amount of $15,000 for improvement of streets and $25,000 for constructing water works.

Ore., Creswell—Special election July 18 for voters to pass upon proposal to purchase and improve present water plant and construct new one.

S. C., Fort Mill—An issue of water bonds to the amount of $9,000 is under consideration.

S. D., Beresford—City plans to improve waterworks and power plant Abt. $70,000. Dakota Eng. Co., Mitchell, engineers

S. D., Beresford—City authorized issuance of $70,000 bonds to build new well at water plant, purchase engine for electric plant, etc. W. M. Yorker, clerk.

Tex., Magnolia Park—City voted $500,000 for water works, sewer and street improvements, fire equipment, etc. The mayor.

Tex., Dallas—Water department of Oak Cliff Station plans construction 1,000,000-gal. capacity reservoir. J. B. Winder, chief engineer.

Tex., Rising Star—A recent election resulted in favor of issuing the following bonds: Water $35,000; street, $35,000; sewer, $30,000.

Tex., Fort Stockton—The election held recently resulted in favor of issuing water works bonds to the amount of $75,000.

Tex., Karnes City—An election was held June 21 to vote the issuance of water bonds to the amount of $65,000.

Tex., Rising Star—Bond issue of $35,000 recently voted. The mayor.

Tex., Chillicothe—City voted $110,000 bonds to install water and sewer systems. The mayor.

Va., Norfolk—City is considering appropriating $109,187.07 for installation of 5 miles of water mains. Walter H. Taylor, 3rd, director of public works.

Wash., Auburn—An issue of $125,000 water system bonds was voted on; widening various streets, etc.

Wash., Spokane—Water department will immediately make a survey of water main on 21st ave., which is reported rotted beyond point of usefulness.

Wash., Creston—Bond issue of $20,000 for new water works system carries.

Wash., Walla Walla—City sells $500,000 water works bonds to investment bankers, providing funds for project.

Wash., Walla Walla—All bids were rejected as too high, and Ernest B. Hassey, consulting engineer of the city, authorized to prepare new plans for a reservoir to be built on the flat, with cost not to exceed $250,000.

Wash., Seattle—Construction of a 3d municipal pipe line from Swan Lake to city and establishment of Volunteer Park distributing reservoir vigorously urged by City Engr. Dimock.

Wash., Sumner—Special election will be held in Sumner for voting bonds in the sum of $45,000 for additions, betterments and extensions to the water supply and distributing system of the town.

W. Va., St. Albans—St. Albans Water & Light Company will construct filtration plant at an approximate cost of $75,000. E. B. Tisdale, director of sanitary engrs., State Dept. of Health.

BRIDGES

Ala., Montgomery—Bridges will be constructed in Blount County (with fed. aid) at an estimated cost of $23,320.

Cal., Dunbarton—Construction of auto and pedestrian bridge proposed.

Conn., New Haven—City plans to build rein.-con. and steel highway bridge over Quinnipiac river, on Forbes ave. About $400,000. E. S. Nettleton, city engr. E. W. Wiggin, 115 Church st., cons. engr.

Fla., Jacksonville—Commission voted to construct 24-ft. bridge over Townsend rd.

Fla., Fort Pierce—Bridging Indian river contemplated at Jensen.

Fla., Jacksonville—Bids soon called for construction of bridge over McGirts Creek, 150 ft. long, 57 yd. fill for approach.

Ia., Dubuque—90-foot bridge (wood), spanning creek one mile from Jackson county line ordered closed for repairs.

Ida., Boise—350-ft. steel bridge will be built over Payette river.

Ind., Indianapolis—Extensive bridge program p anned by State Hwy. Comn. estimated at $1,000,000.

Ind., Indianapolis—The State Highway Dept. contemplates a $1,000,000 to $2,000,000 bridge building program for 1921

Ind., Daviess Co.—The comrs meet at Washington, on July 5, to open bids on four bridges.

Ind., Indianapolis—Funds available to place approaches to sidewalks and roadways of Senate Bridge.

Kans., Larned—Pawnee Co. plans 500 ft. bridge over Arkansas river, having 10 spans of reinforced concrete girder type.

Mass., Boston—It is proposed to rebuild Saugus river bridge of concrete, $150,000.

Mass., Westboro—The towns of Westboro and Northboro plan to build concrete arch over Assabet river.

Mich., Lansing—The Michigan State Highway Dept. is interested in securing a second-hand steel or wrought iron superstructure for a 175-ft. single-span bridge providing a clear roadway, width preferably of not less than 18 ft.

Michigan—State Highway Dept., Lansing, plans to build bridge 580,701, 100 feet long, and Bridge 580,101, 90 feet long, both Monroe co.

Mo., Boonville—Campaign stated to complete one-half million dollar fund for bridge across Missouri river. Boonville has subscribed $346,000, Columbia $30,400.

Mo., Kansas—Plans for new bridge across Kaw River considered.

Mont., Missoula—New $10,000 bridge will be built across Flathead river.

N. C., Charlotte—Survey being made for bridge over Catawba river at Buster Boyd site. Steel const. with creosoted plank roadway covered with asphalt in surface.

"PIONEER"

HIGHEST QUALITY ASPHALTS

Any Melting Point. Any Ductility. Any Penetration.

"PIONEER" Expansion Joint No. 1 is specified, recommended and used by those engineers and contractors who take pride in their work, and still believe in quality.

"PIONEER"

RUBEROAD CEMENT

It's New—It's Different—It's Efficient

It sticks to concrete like molasses sticks to fingers. Repair your concrete cracks with it. Two men, a broom, shovel and hoe all the equipment required.

THE PIONEER ASPHALT CO.
LAWRENCEVILLE, ILL.

WIARD PLOWS

Contractors' Plow No. 69

This plow is intended for use with either animal power, a traction engine or road roller.

For all Road or Contractor's work—for tearing up cobblestones and macadam—it can be used as a perfect *Rooter and Pavement Plow* by simply removing the steel wing below the moldboard—thus making *a two in one Plow* for all around work.

WIARD PLOW COMPANY
BATAVIA NEW YORK

Compressed Stone Base for Warrenite-Bitulithic Pavement

This form of base has been thoroughly and successfully tested for many years under widely varying climatic and subsoil conditions, and has proven eminently satisfactory, including over 200 miles on the Columbia River Highway, Oregon, shown in illustration below.

COLUMBIA RIVER HIGHWAY, PORTLAND, OREGON
Warrenite-Bitulithic Surfacing over Old Macadam Sandy Road. Approach to the Columbia River Highway at Sandy River Bridge

Service & Quality

The essential features in laying of Warrenite-Bitulithic.

We furnish expert laboratory service with every pavement laid. The result is shown by the phenomenal growth of Warrenite-Bitulithic.

Insist on The Warren Way

Illustrated booklet on Compressed Stone Base furnished upon request as well as other features of Warrenite-Bitulithic

WARREN BROTHERS COMPANY

Executive Offices: 9 Cambridge St., Bowdoin Sq., Boston, Mass.

DISTRICT OFFICES:

Utica, N. Y.	Chicago, Ill.	San Francisco, Cal.
New York, N. Y.	Phoenix, Ariz.	Memphis, Tenn.
Portland, Ore.	Toronto, Ont.	Richmond, Va.
Vancouver, B. C.	Minneapolis, Minn.	Los Angeles, Cal.
St. Louis, Mo.	Washington, D. C.	Winnipeg, Man.

Neb., Omaha—Bridge collapsed over Big Cottonwood creek near Whitney, Neb.

N. J., Trenton—Bids will be readvertised for bridge and tunnel Bonds. $6,000,000. All bids were rejected.

N. J., Trenton—State Hwy. Comn. has passed resolution to set aside funds to pay state's share of cost of erecting the Perth Amboy bridge.

N. Y., Albany—Cohoes bridge to cost $572,000 and completion in 15 months. Contracts will be awarded July 1.

N. Y., Buffalo—New footbridge across arm of Bunnell Pond in Beardsley Park proposed. $10,000.

O., Dayton—City plans to build 6 reinforced concrete slab bridges over Erie and Miami Canal on Main, Jefferson Warren, Stout, Apple and Stewart sts. About $85,000. G. Baker, city engr.

O., Fremont—Co. Comn. proposes to build $250,000 bridge across Sandusky, concrete, 4474 feet long, 61 ft. wide.

O., Dayton—Troy pike bridge will be repaved and repaired. $8,500.

O., Belhaire—Banks of city have bought Belmont Bridge bonds.

Okla., Lawton—Several bridges carried away or damaged by river flood.

Ore., Eugene—Eugene voters at special election rejected proposal to issue $60,000 bonds to build bridges in city and reject $15,000 bonds for paving st. intersections.

Ore., North Bend—James H. Owen, president, California & Oregon Lumber Co., Brookings, Ore., completing crosssection of 14 miles main line railroad. Project comprises several large bridges, also minor ones and grading. Contracts will be let for whole or any part of work late in June. The project entails the expenditure of about $500,000.

Pa., Pittsburgh—Plans will be prepared for reconstruction of Point bridge.

Pa., Gettysburg—Conewago Creek br. broken by big truck.

Utah, Wallsburg—Railroad bridge over Provo river collapsed.

Utah, Mt. Pleasant—Bridge washed out in eastern part of city, disturbing power and light system by excess water supply.

Vt., Brattleboro—Steel bridge 330 ft. long being built over Connecticut river, collapsed.

Wash., Seattle—Business interests will endeavor to raise $24,500 within 10 days to help in the construction of the Benton-Franklin inter-county toll bridge over the Columbia river, near Kennewick.

Wash., Yakima—The north bridge of the Toppenish-Buena road has been closed to traffic because the high water has washed out one of the approaches.

LIGHTING AND POWER

Ala., Wauchula—A new electric light plant, ice plant and cold storage plant will be erected in this city at a cost of about $200,000. J. G. Fancy of Fort Mead interested in project.

Ariz., Phoenix—The Southern California Edison Co. plans to develop hydroelectric energy from the Colorado River. The project will involve an expenditure of about $100,000,000. John B. Miller of Los Angeles, is president of the Edison Company.

Ala., Fort Payne—The electric lighting plant at Fort Payne will be improved by overhauling the plant, installing new generators and other machinery. A. A. Miller, electrical engr., of Chattanooga.

Ga., Augusta—Board of Commerce considers the electrification of the canal.

Ia., Shell Rock—Franchise was granted W. M. Boe of Waverly and E. R. Smith, Chicago, Ill., to erect an electric power plant and dam at Shell Rock, Ia.

Mass., Boston—The New England Power Co. contemplates enlarging its power facilities in the western part of Massachusetts.

Neb., Lincoln—Resolution introduced asking that bids be advertised for construction of new power plant at A st., water and electric station, $150,000.

N. Y., Boro Brooklyn—Local Board considers contract of Murphy Bros. for restoration of gas mains along route 22.

N. Y., Binghamton—Board of Estimate and Apportionment approved an ordinance providing for the construction of an ornamental lighting system on Water street.

O., Hamilton—City Council appropriated $5,000 for employment of engineer to make preliminary survey of municipal lighting plant.

O., Hamilton—This city plans the construction of a $650,000 elec. light plant.

O., Middletown—The city comsn. will initiate legislation to comply with recommendations of the Chamber of Commerce for ornamental lighting on various street, sidewalk widening, removal of overhead wires and unsightly poles, redistricting city and condemnation of property between M. & E. canal, and Clinton, Second and 3d sts.

Okla., Sayre—Election held June 15 to vote electric light bonds, $40,000.

Tex., Dallas—The Dallas Gas Co. contemplates extensive improvement which calls for a bond issue of $2,500,000.

FIRE EQUIPMENT

Ala., Birmingham—$3,200 fire dept. bonds to be purchased, 5 per cent.

Conn., Hartford—$120,000 appropriation available for proposed site for Fire House.

Conn., Stratford—Purchase of triple combination motor apparatus is under consideration.

Ind., Terre Haute—Two new combination hose and chemical fire trucks will be bought by the board of public safety. The city council has appropriated $9,000 for the purpose.

Ind., Indianapolis—Board of public safety issued orders changing system for receiving and handling fire alarms and system under which motor pumpers are operated.

Ky., Covington—A fire at Burlington, Ky., county seat of Boone county, did $30,000 in damages and threatened to wipe out the place. Cincinnati firemen responded to an appeal for help and found nothing but cisterns for a water supply. A dozen of these were drained before the fire got under control.

Mich., Detroit—Oakwood village near here suffered a $25,000 fire loss. The place has no fire protection. In this case the telephone wires were at once burned and it was a long time before the Detroit fire department could be reached.

N. Y., Buffalo—John F. Malone, comr. of parks and public buildings closes bids today for remodeling police station No. 1 at Franklin and W. Seneca st

O., Middletown—Fire dept. is in need of new and modern fire equipment

O., Struthers—City council has ordered that a pressure pump be purchased for testing old and new hose.

O., Ravenna—Safety director recommends installation of new fire alarm system.

O., Findlay—Inability to sell six per cent bonds has caused the council to postpone till next year the motorization of the Findlay fire department.

O., Struthers—The council has authorized the purchase of a pressure pump for testing new hose and making a test of old hose. Mr. Dutmar is the fire chf.

O., Toledo—A two-story stucco garage and servants quarters at the country home of W. E. Bock, Eagle Point Colony, near Rossford, has been burned to the ground with $25,000 loss. Firemen from No. 10 engine house East Side laid 1,200 ft. of hose but were unable to reach the flames.

O., Toledo—The council has authorized a $125,000 bond issue to motorize a portion of the division of streets equipment including that used in garbage collection. Among the larger vehicles to be purchased will be a caterpillar type tractor, 6 one-ton trucks, 4 roadsters, 4 tractor dump trucks and 30 garbage collection trailers.

Pa., Bellefonte—Funds have been raised for purchase of new fire apparatus.

Tex., Dallas—Additional motor apparatus for fire department may be provided in annual budget now being considered by the board of commissioners. Chief Myers recommends that the six pieces of motor apparatus now being used be replaced as they are no longer fit for service.

MISCELLANEOUS

Cal., Sacramento—Governor signed Senate Bill No. 955, appropriating $20,000 toward survey of the feasibility of taking water from the Klamath river for irrigation of lands in the Shasta Valley in Siskiyou county.

Cal., San Francisco—Tooel Irrigation project being considered containing 65,000 acres, by Water Storage Assn.

Conn., Hartford—Common Council appoints committee to prepare plans for comfort station, $30,000.

Ill., Chicago—Plans in progress involving expenditure of $3,500,000 for bathing beach, park blvd., quays, etc.

Ill., Decatur—Clearing land for proposed reservoir will cost $100,000.

Ind., Indianapolis—$200,000 will be spent for development of playgrounds; $98,000 for golf course; $175,000 for swimming pools.

Mo., Kansas City—Park Board rejects petition to condemn property for public playground.

N. Y., Boro Richmond—Local board plans improvement of Clove Lakes Park

N. Y., Boro Manhattan—Appropriation of $225,000 requested to construct station extension at 149th st. Rapid Transit R. R.

N. Y., Jamaica Bay—$750,000 appropriation made for building bulkhead, platforms and dredging channel at Mill Basin.

O., Canton—Service director Smith is authorized to advertise for bids for dredging and straightening East Creek. The city has recently sold $214,000 of the bonds.

O., Chillicothe—Contracts will be let at once for tearing down wooden walls along Worthington run and replacing them with concrete. The Utilities dept. at Camp Sherman has received an order to do this work at a cost of $7,622.

O., Bellefontaine—The counties of Logan Auglaize and Shelby are considering jointly dredging the Miami river and Muchinippi creek at an expense of $200,000. The removal of a mill dam in the Miami at Quincy is involved.

Tex., Clarksville—Has authorized an issue of $80,000 6 per cent 30 year Levee bonds dated May 1, 1927

Wash., Seattle—A survey of the Lake Washington canal system with a view of widening and deepening the canal to permit passage of vessels of greater size.

Wash., Munson—Additions and extensions to the irrigating system which will probably involve an outlay of $250,000 when completed are under way.

Washington—Purchase by government of Cape Cod canal for $11,500,000 recommended to Congress.

Mex., Mexico City—Naval building program calling for an expenditure of a sum of $100,000,000, covering a period of 10 years, has been outlined by the Department of Army and Navy.

For Garbage Collection

HEIL BODIES

HYDRO HOISTS

This three-yard welded steel garbage body is one of several used by the city of Madison, Wisconsin. It is fitted with six covers, steps for loading, and a special water-tight tail gate. The body is raised and dumped with a Heil Hydro Hoist, which allows the use of all the loading space back of the cab.

We will be pleased to consult with you regarding your requirements.

THE HEIL CO.

1132-50 Montana Ave., Milwaukee, Wis.

Welded Storage Tanks—All Kinds and Capacities

TRADE MARK REGISTERED

KOPPEL

U S PATENT OFFICE

On Every Big Job!

KOPPEL cars of various types are used by practically all large contractors.

We carry at all times a complete stock of cars, dinkeys, track, switches, etc., ready for prompt shipment.

An attractive rental proposition is offered to you also.

KOPPEL INDUSTRIAL CAR AND EQUIPMENT COMPANY

Koppel, Penna.

Sales Offices:

New York City — Philadelphia
Chicago — San Francisco
Pittsburgh — Detroit

REGISTERED TRADE MARK

ACME GRAVEL SCREENING PLANT

This type of screener has proven its efficiency in point of economy, power and saving in labor. Requires a few minutes only for one man to put in or take out of operation.

Continuous bucket loading elevator. This plant can be used for unloading stone, gravel, sand or coal, simply by removing screen

Indispensable for road contractors, who value time in loading.

We also manufacture brushes, screens, bins, elevators, graders, road rollers, unloading plants, etc.

Catalog showing full line on request.

ACME ROAD MACHINERY CO.

FRANKFORT, N. Y.

SAVES POWER and LABOR

QUALITY *Kinney* EFFICIENCY

Asphalt and Tar Sprayer

The Standard of Efficiency and Economy

Get Our Complete Catalogue

Kinney Manufacturing Co.

Boston, Mass.

NEW YORK — CHICAGO — SAN FRANCISCO
KANSAS CITY — HOUSTON — PHILADELPHIA

TOO LATE FOR CLASSIFICATION

BIDS ASKED FOR

STREETS AND ROADS

Ill., Chicago 11 a. m., June 27
For paving certain streets.—Michael J. Faherty, pres., Board Local Impvs.

Ill., Chicago 11 a. m., June 28
For street improvement.—Michael J. Faherty, pres., Board Local Impvs.

Ind., Brazil 10.30 a. m., July 14
For G. M. Rogers et al, John Leslie and O. B. Shaley rds.—Wiley E. Parrish, Clay Co. aud.

Ind., Martinsville 2 p. m., July 6
For J. J. Hase rd.—H. H. Nutter, Morgan co. aud.

Ind., Miami Co. noon, July 6
For grading, paving, etc., on Aaron Michael and E. L. Coppock rds.—Chas. Wolf, co. aud.

Ia., Rockingham 8 p. m., June 27
For sidewalks and alley crossings.—J. J. Becker, town clk.

Minn., Duluth 11 a. m., June 27
For improvement of alleys—F. D. Ash, city clk.

N. J., Montclair 4 p. m., June 30
For concrete curbs on Oxford st.—Harry Trippett, town clk.

N. Y., Albany noon, July 13
For improving and repairing highways in various counties.—Herbert S. Sisson, comr. hwys.

Utah, Salt Lake City 10 a. m., July 5
For grading and constructing curb, gutter and pavement.—W. A. Leatham, city recorder.

Wash., Mt. Vernon July 5
For concrete Pacific Hwy. through Burlington.—Co. Comrs.

SEWERAGE AND SANITATION

Ill., Chicago 11 a. m., June 27
For sewers.—Michael J. Faherty, pre., Bd. Local Impvs.

Ill., Chicago 11 a. m., June 28
For sewers.—Michael J. Faherty, pre., Bd. Local Impvs.

WATER SUPPLY

N. J., East Orange 8 p. m., June 27
For laying water mains.—R. M. Roper, engr., 426 Main st.

O., Dover June 28
For extension of water lines.—Board Control.

LIGHTING AND POWER

N. J., East Orange 8 p. m., June 27
For street lighting.—Lincoln E. Rowley, city clk.

O., Dover June 28
For replacement of equipment of city light plant.—Board Control.

BRIDGES

N. J., Mount Holly 9.45 a. m., July 1
For bridge spanning Assiscunk crk.—Alfonza Adams, clk., Board Chosen Freeholders

O., Cincinnati noon, July 1
For concrete floor for Bridge No. 9, Zion Hill road.—A. E. Mittendorf, pres., Co. Comrs.

MISCELLANEOUS

N. J., Elizabeth 3 p. m., June 28
For road roller.—Herman Kling, co supvr. roads.

N. J., Mt. Holly 10 a. m., July 1
For Cletrac tractor.—Alfonza Adams, clk., Board Chosen Freeholders.

WORK CONTEMPLATED

STREETS AND ROADS

Cal., San Francisco—$20,000,000 will be spent on state highway and post rds. by Federal Government along Pacific coast.

Conn., Hartford—Common council plans to extend Dexter st. also new curb lines in other sts.

Fla., Palatka—$30 000 will be expended on 40 blocks of streets, vitr. brk.

Ia., Lehigh—Good Roads Comn held meeting to consider plans for Scenic Highway along Des Moines river, thru Dolliver Memorial Park, connecting Ft. Dodge and Lehigh.

Ia., Clinton—Petition circulated for oiling various sts. F. W. Leedham, city clk.

Ia., Davenport—City will construct sidewalks and crossings by day work.

Ky., Pineville—Immediate construction of Dixie Highway in Bell Co. planned. $100,000 appropriated.

Kentucky—Northern Kentucky Good Roads Association plan to issue $500,000 bond issue at coming election. Fed. Aid $500,000

La., Amite—$325,000 Good Road bonds adopted for road district 1, ward 7, to build 31 miles of model road near Pouchatoula.

Minn., Red Lake Falls—City council will construct cement sidewalk and st. and alley crossings, various sts .

Minn., Mankato—Blue Earth co. Will consider bids for gravel loader.

Minn. Duluth—Will call for bids soon for paving 12th ave., estimate, $3,229.

Minn., Duluth—Will call for bids soon for paving Michigan ave. from Grand ave. to Wicklow street, concrete, $12,-057.

Minn., New Ulm—City making plans for grading various streets this year.

Mich., Ironwood—Street to Hurley to be paved with brick, concrete or tar macadam.

Minnesota—State plans to improve over 200 miles of roads and 5 bridges to be constructed.

N. C., Salisbury—$500,000 voted for municipal purposes.

N. C., Gastonia—Co. Comrs plan to improve three roads this summer. Bond issue of $800,000.

Neb., Fremont—City council petitioned for new boulevard, from Fremont Country Club to Broad street, about 33 feet wide, to be continuation of Lincoln highway. F. G. Pierce, city clk.

N. Y., Albany—Ordinance passed to pave and sewer Wendell alley.

N. C., Winston-Salem—Highway Com. planning immediate construction of 482 miles of roads at cost of $7,000,000.

N. Y., Middletown—Ordinances passed to pave five streets and construction of sewers.

N. Y., Rome—One bid received on $13,000 bond issue for paving and drainage.

O., Columbus—City council passes resolution to improve various streets and alleys by paving, brick or concrete, and laying water and sewer connections.

O., New Lexington—Crooksville road, 3-4 mile, to be paved with Kentucky asphalt, $165,000.

O., Fostoria—Co. plans straightening and narrowing of Big Spring twp.

O., Middletown—Pike to be resurfaced at $140,000.

O., Lisbon—Three streets to be paved with brick block on concrete base, also 1-2 mile Brighton road.

S. C., Fort Mill—County will constr. sand clay road or more permanent form road from Kimballs to South Carolina line, also road from Fort Mill to North Carolina line; $75,000 voted for roads.

Tex., Denison—$600,000 appropriation available for paving streets.

Tex., Galveston—City proposes paving 25th st.

Tex., Cleburne—$1,000,000 worth of road work to be awarded soon. Two rd. projects planned.

Wash., Seattle—City council passes resolution to improve various streets.

Wis., Superior—Contracts will soon be awarded on several minor road jobs.

SEWERAGE AND SANITATION

Fla., Inverness—The J. B. McCrary Engineering So., Atlanta, Ga., has made survey for proposed sewerage system and will submit plans soon. The mayor.

Ga., Dalton—City plans to extend the sewers on Morris and Green sts.

Minn., Breckenridge—Resolution was adopted directing sewer main on 7th st.

Minn., Duluth—Sanitary sewer ordered constructed, $1,600.

Neb., Benkelman—Sewerage system contemplated. Engrs., Royal D. Salisbury Co., Denver, authorized to make tentative plans.

O., Toledo—Ordinance passed to proceed with construction of sanitary sewer No. 1349.

Okla., McAlester—Construction of additions to sewerage system planned.

O., New Philadelphia—City council has enacted legislation for sanitary sewers in Ray, Miller, Kelley, Wabash and Union sts., $6,000.

WATER SUPPLY

Fla., Inverness—The J. B. McCrary Engineering Corporation, Atlanta, Ga., has made survey for proposed water works system and will soon submit the plans. The mayor

Fla., Jacksonville—City is considering buying and improving water works system in Riverdale Heights. John W. Martin, mayor.

Fla., Palatka—City is proceeding with plans to acquire water works p ant and consolidate with municipal system; purchase price, $85,000; $45,000 will be expended in consolidating the plants and installing new mains. The mayor.

Ga., Helen—City will offer $30,000 of water works bonds for sale. W. R. Ault, town clerk.

Minn., Red Wing—At special meeting, Water board decided to purchase 6 and 8-in. cast iron pipe for water mains. Also 4 hydrants and necessary fittings.

Mo., Poplar Bluff—$47,000 bond issue was carried to be used for purchasing water mains, motor fire apparatus and bridge repairs.

N. D., Steele—Plans in progress for water works system for fire protection, includes fresh water well, etc. $33,000.

Neb., Beatrice—Will drill 4 test wells for additional water supply.

Neb., Albion—Will probably call for bids for constructing extension to water mains in Water Main Ext. Dist. 7.

Neb., Dunbar—Will construct well, and install water system later.

Neb., Grand Island—Ordinance passed creating Water Main District 6.

Neb., Holdredge—Water Main Dist. 6 created. Start work on extend mains soon. W. Lindstrom, city clk.

Neb., Seneca—Ordinance passed creating Water Works System in city. Con-

THE BUFFALO-SPRINGFIELD PRESSURE SCARIFIER

can be attached in the field to a macadam roller already in service. New Buffalo Pitts and Kelley Springfield rollers can be equipped with pressure scarifiers when so ordered. Unequalled for efficiency and economy.

Buffalo Springfield Roller Company, Springfield, Ohio
MANUFACTURERS

Mechanical Filtration Plants

for

Municipal and Industrial Purposes

also

THE "HOLYOKE"
FIRE HYDRANT

Norwood Engineering Company
FLORENCE MASS.

A Service Tested Wire Rope

The use of HERCULES (Red-Strand) Wire Rope on heavy duty equipment is not an experiment, for its many years of actual service have demonstrated that it is a safe and economical rope for such conditions. Its one red-strand is our guarantee of constant quality.

Established 1857

A. LESCHEN & SONS ROPE CO.
St. Louis, Mo

New York, Chicago, Denver, San Francisco

VITRIFIED CLAY PIPE

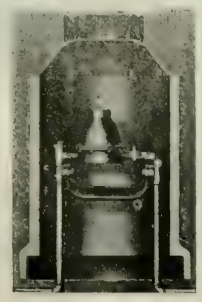
When You Need It

Highest grade that the art in the industry can produce.
Our plants are so located and the production so large that we can guarantee satisfactory service.

Our line also includes—
Wall Coping—Flue Lining—Stove Pipe
Building Blocks—Paving Brick—Drain Tile
Fire Clay—other Clay Products.

Before placing your order, write us.

THE DELAWARE CLAY PRODUCTS CO.
611-614C Arrott Building Pittsburgh, Pa.



A Meter Well Bought Is Not Half Set

We believe that the curb is **the only** logical place for a water meter, for the following reasons:

A.—Meter is safe from frost damage.
B.—Meter is safe from tampering.
C.—All water entering property is registered and leaks on inside piping will be promptly repaired.
D.—Meter is less liable to damage from hot water backing up from range boiler when located at curb.
E.—Ordinary curb box and curb stop may be done away with if desired.

There are a lot of other reasons, and meter boxes are cheap. Write us.

FORD METER BOX CO. Wabash, Indiana

OFFICIAL ADVERTISING

HIGHWAY WORK

OFFICE OF THE STATE COMMISSION OF HIGHWAYS, ALBANY, N. Y.

Sealed proposals will be received by the undersigned at their office, No. 55 Lancaster street, Albany, N. Y., at one o'clock, p. m., advanced standard time which is twelve o'clock noon eastern standard time, on Wednesday, the 6th day of July, 1921, for the improvement of highways in the following counties:

Cayuga .....(approx. 5.39)
Hamilton, one completion (two highways: 3.02 and 6.72)
Livingston .....(approx. 2.16)
Monroe .....(approx. 3.69)
Niagara .....(approx. 2.49)
Rockland .....(approx. 3.85)
Steuben.....(3 hwys.: 3.95, 1.73, 0.26)
Warren .....(approx. 0.05)
Washington .....(approx. 2.39)
Yates .....(approx. 1.70)

Also for the Repair of Highways in the Following Counties—Reconstruction

Clinton .....(one contract)
Monroe .....(one contract)
Otsego .....(one contract)
Steuben .....(one contract)

Maps, plans, specifications and estimates may be seen and proposal forms obtained at the office of the Commission in Albany N. Y., and a so at the offices of the division engineers in whose division the roads are to be improved or repaired. The addresses of the division engineers and the counties in which they are in charge will be furnished on request.

The especial attention of bidders is called to "General Information for Bidders" in the itemized proposal, specifications and contract agreement.

HERBERT S. SISSON,
Commissioner.

J. C. FINCH,
Acting Secretary.

(25-26-27)

HIGHWAY WORK

OFFICE OF THE STATE COMMISSION OF HIGHWAYS, ALBANY, N. Y.

Sealed proposals will be received by the undersigned at their office, No. 55 Lancaster street, Albany, N. Y., at one o'clock p. m., advanced standard time which is twelve o'clock noon eastern standard time, on Wednesday, the 13th day of July, 1921, for the improvement of highways in the following counties:

Chautauqua .....(2 hwys.: 1.32 & 2.84)
Cortland .....(approx., 3.67)
Delaware .....(approx., 4.98)
Greene .....(2 hwys.: 4.13 & 3.98)
Ontario .....(2 hwys.: 3.20 & 8.81)
Rensse'aer .....(2 hwys.: 1.95 & 5.46)
St. Lawrence .....(2 hwys.: 5.74 & 6.45)
Seneca .....(approx.: 3.20)
Steuben .....(2 hwys.: 4.03 & 2.85)
Yates .....(approx.: 8.81)

Also for the Repair of Highways in the Following Counties

RECONSTRUCTION

Erie .....(one contract)
Genesee .....(one contract)
Jefferson .....(one contract)
Westchester .....(one contract)

Maps, plans, specifications and estimates may be seen and proposal forms obtained at the office of the Commission in Albany, N. Y., and also at the offices of the division engineers in whose division the roads are to be improved or repaired. The addresses of the division engineers and the counties in which they are in charge will be furnished on request.

The especial attention of bidders is called to "Special Information for Bidders" in the itemized proposal specifications and contract agreement.

HERBERT S. SISSON,
Commissioner.

J. C. FINCH,
Acting Secretary.

(26-27-28)

PROPOSAL

Sealed proposals will be received by the Town Council of the Borough of Somerset until 2.00 p. m., Tuesday, July 5, 1921. For the grading, paving and curbing of East Catharine street from North Main Cross street to North East street in the Borough of Somerset, Pa. Plans and specifications can be seen at the office of the undersigned, in the Municipal bldg., or Fluck & Moore Borough Engineers Somerset, Pa. A certified check for $500 must accompany each bid, and successful bidder must give bond in the sum of $2,000. All bids to be sealed and marked "Bids for paving East Catharine St." and addressed or delivered to the undersigned or Fluck & Moore, Borough Engineers, Somerset, Pa. No bids will be received after the expiration of the above time, and Council reserves the right to reject any or all bids. The above paving is to be of concrete and will require approximately 1,650 yards of material.

C. E. PILE, Secy.

(26)

EQUIPMENT BARGAINS

Wrought Pipe Rethreaded

For your new road contract you will want pipe for your water service. Our used pipe, rethreaded and coupled, will answer your requirements the same as new pipe and will save you considerable money. We carry all sizes from ¾ to 12 inches, have large stock, 1, 1¼, 1½, 2, 2½, 3 and 4 inches.

Marine Metal & Supply Co.
167 South St., N. Y. City
137-147 Fifteenth St., Jersey City

Contractors Equipment

Concrete Mixers, Road Rollers, Steel Piling, Pipe, Locomotives, Cars, Rails, Track Accessories, Tanks, Pumps, Boilers, Engines Motors, Crushers and Steam Shovels.

ZELNICKER IN ST. LOUIS

Have You Received YOUR Copy Bulletin 290?

LIGHTING AND POWER

Ia., Iowa Falls—Plans in progress for building electric light plant, $150,000. Will hold meeting to hold bond issue.

Minn., Redwood Falls—Will install white way; $8,000 bonds voted. $14,000.

Minn., Mankato—Site purchased at W. Front and Moreland ave. for erection of transformer. Owner, Northern States Power Co. Minneapo is, Minn.

Minn., Duluth—City comrs. ordered Duluth Edison Electric Co. to install cluster lights, ornamental type, on 12 sts.

Minn., Duluth—Considering purchase additional elec.-driven pump at Lakewood pumping station.

N. D., New England—Extension of white way on Main st. ordered.

Neb., Ogallala—City installing elec. pumping system. Care city clk.

N. D., Verona—Contemplate erecting electric light plant. Care city clk.

S. D., Watertown—Letting postponed to June, on contract for additional power plant equipment in municipal plant.

S. D., Beresford—City will purchase new engine for municipal electric light plant. Care city clerk.

Wis., Wausau—Annual meeting held executive comm. and mgr. instructed to proceed with construction of reservoir and dam at Spirit river. Owner, Wisconsin Valley Impvt. Co. $100,000.

Wis., Kenosha—Will submit petition for ornamental lighting system on Main st and Milwaukee ave. to council meeting.

MISCELLANEOUS

Ia., Boone—Plans made for Drain 172. Civil engr., Hugh A. Chambers, Boone.

sists of plant and apparatus, fixtures & machy.

Neb., Valentine—Contemp'ate installing municipal gravity water system here. J. H. Quigley, mayor.

O., Cleveland—Plans for furnishing a gravity supply of drinking water for Cleve and, Akron, Kent, Youngstown and Warren are beig revised.

Tex., Big Spring—$65,000 bond issue for improvement of city water works has been purchased.

Tex., Terrell—City comm. decides to have new water standpipe erected, $250,000.

Tx., Breckenridge—Building $1000,000 water supply works.

BRIDGES

Fla., Tampa—New bridge planned. Caren to Platt St. site suggested.

Mass., Lynn—Bridge destroyed by fire will be closed all summer.

N. D., Bismarck—200 feet of temporary bridge over Missouri river used in contruction of new vehicular bridge gave way.

Mich., Grand Rapids—New bridge to be constructed at Pearl st.

Okla., Muskogee—County issued $400,000 bonds for bridges. Federal government will match bonds.

S. C., Union—City will extend sewer lines. The Mayor.

FILTERS

Hypochlorite Apparatus and Water Softening Plants

The New York Continental Jewell Filtration Company

General Offices and Works: NUTLEY, N. J.

111 West Monroe St., CHICAGO New Birks Bldg., MONTREAL

Liquid Chlorine

Electro Bleaching Gas Co.
PIONEER MANUFACTURERS of LIQUID CHLORINE
Plant NIAGARA FALLS N.Y.
Main office 11 East 44th Street New York Chicago office 11 So La Salle St

Ia., Rockwell City—Will construct Drainage District 16-31, in Johnson and Fulton twps. Webster co., and Lincoln and Greenfield twps., in Calhoun co.

Ia., Marshalltown—Will report on extension of Hardin co. Drainage Dist 121 as Joint District.

Minn., Redwood Falls—Redwood co. Hearing on Ditch 64 postponed till Jan 4, 10 a. m., 1922.

Mont., Hamilton—Will repair ditches of Bitter Root Irrigation system.

Miss., Yazoo City—Yazoo County Supervisors are considering constructing levee to protect territory between Pines creek and Yazoo City from flood waters. will make surveys to determine cost.

Miss., Cleveland—Central Drainage District Comrs., Bolivar co., will construct canals and ditches. W W Boone engr.

Miss., Batesville—Extension of Yocona-Tallahatchie Drainage District to Greenwood, Miss., permitted by Chancellor J. G. McGowan will drain surplus water of Mississippi delta north of [illegible] Cost of project and system $[illegible] J W Martin, Yazoo, Miss. attorney [illegible] clerk.

Neb., Whitney—[illegible] contract for [illegible] tank project. [illegible] Acres land.

Neb., North Platte—[illegible] county Survey made for Drainage District 1. Bonds sold A. E. Allen, [illegible] clerk.

S. D., Volin—Yankton co. Meeting held to consider matter of extending Volin lateral D. D. 1. Jesse D. McGrath [illegible] aud.

Expert Information by Experienced, Practical Men

FREE ASSISTANCE TO OUR READERS

PUBLIC WORKS receives many requests daily from its subscribers and advertisers. Some of them want help on work that is new and unusual. Others want information concerning machinery, tools, equipment, supplies. They ask us to recommend what is best suited for the purpose and to tell them where to buy it. This service is promptly and freely given. PUBLIC WORKS has a competent staff of practical engineers in its exclusive employ who will answer your requests. Our facilities for gathering and furnishing information are unequalled by any publishing company in the public engineering and contracting field.

Address Information Bureau

PUBLIC WORKS

243 West 39th Street, New York

NEW YORK'S TRIBUTE
TO AMERICAN-LA FRANCE PERFORMANCE

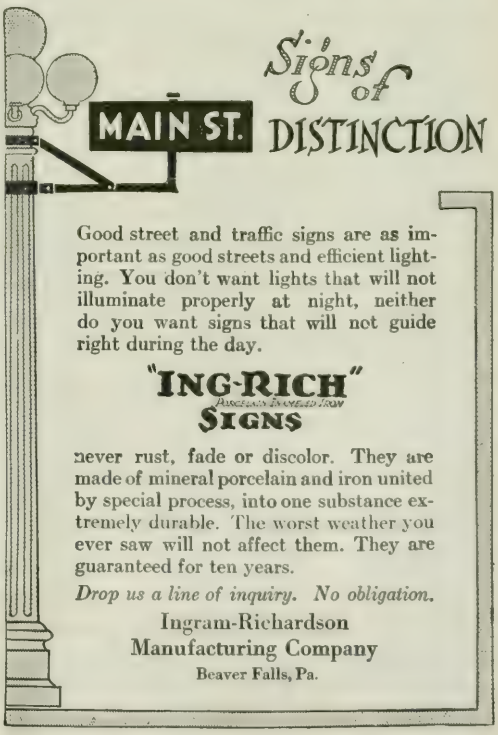
New York City first purchased American-LaFrance Motor Fire Apparatus in 1912. In 1917 an order was received for 25 Pumping Cars, in 1918 an order for 15 more Pumpers of the same type. In 1920, 21 pumpers, and 1921 brought the crowning tribute to the performance of this enormous fleet with a new order for 20 more Pumping Cars.

Each car delivered has undergone a rigid road test, and a twelve-hour pumping test. This is a record without parallel and one that can never be surpassed. 113 pieces of motor apparatus, including 81 Pumping Cars, in our largest city, furnish a convincing testimonial to the unapproachable position occupied by American-LaFrance Motor Fire Apparatus.

AMERICAN-LAFRANCE FIRE ENGINE COMPANY, INC.

ELMIRA, N. Y.

New York — Boston — Washington — Atlanta
Pittsburgh — Chicago — Minneapolis — Denver
Dallas — Los Angeles — San Francisco — Portland
Canadian Factory—Toronto, Ont.



Signs of DISTINCTION

Good street and traffic signs are as important as good streets and efficient lighting. You don't want lights that will not illuminate properly at night, neither do you want signs that will not guide right during the day.

"ING-RICH" SIGNS

PORCELAIN ENAMELED IRON

never rust, fade or discolor. They are made of mineral porcelain and iron united by special process, into one substance extremely durable. The worst weather you ever saw will not affect them. They are guaranteed for ten years.

Drop us a line of inquiry. No obligation.

Ingram-Richardson Manufacturing Company

Beaver Falls, Pa.

BUYERS' CLASSIFIED DIRECTORY

of Names of Firms from Whom to Buy Material, Appliances and Machinery Needed by Public Works Departments and Contractors

CONTRACTORS' EQUIPMENT

(See Paving Machinery also)

Aerial Tramways
Leschen & Sons Rope Co.

Asphalt Block Press
Nat'l Moulding Press Corp.

Air Compressors
Sullivan Mchy. Co.

Ash Handling Machinery
Blaw-Knox Co.

Asphalt Block Press
Nat'l Moulding Press Corp.

Backfillers
Pawling & Harnischfeger Co.

Bar Benders
Koehring Mch. Co.

Barges
American Bridge Co.

Blasting Powder
Du Pont de Nemours Co.

Braces, Trench
The Duff Mfg. Co.

Bridges
American Bridge Co.
Blaw-Knox Co.

Bridge & Wharf Timbers (Creosoted)
Wyckoff Pipe&Creo.Co.,Inc.

Buckets, Automatic & Dumping
Blaw-Knox Co.
Hayward Co.

Buckets, Clam Shell, Dragline, Orange Peel
Blaw-Knox Co.
Brown Hoisting Mchry. Co.
Hayward Co.

Cableways
Flory Mfg. Co.

Cars, Dumping and Industrial
Good Rds. Mchy. Co., Inc.
Koppel Industrial Car & Equipment Co.
W. A. Zelnicker Supply Co.

Carts, Concrete
Acme Road Mchy. Co.
E. D. Etnyre Co.

Castings
American Bridge Co.
U. S. Cast Iron Pipe & Foundry Co.

Caterpillar Tractors
Holt Mfg. Co., Inc.

Chutes, Coal
U. S. Cast Iron Pipe & Foundry Co.

Conduits (Creosoted)
Wyckoff Pipe&Creo.Co.,Inc.

Cranes, Locomotive
Brown Hoisting Mchy. Co.
Orton & Steinbrenner

Cranes and Hoists
Brown Hoisting Mchry. Co.
S. Flory Mfg. Co.

Cross-Arms (Creosoted)
Wyckoff Pipe&Creo.Co.,Inc.

Cross-Ties (Creosoted)
Wyckoff Pipe&Creo.Co.,Inc.

Crushers
Acme Road Mchy. Co.
Good Rds. Mchy. Co., Inc.
Gruendler Patent Crusher & Pulverizer Co.
Universal Road Mchy. Co.
W. A. Zelnicker Supply Co.

Derricks
American Bridge Co.

Dinkeys
Koppel Industrial Car & Equipment Co.

Ditchers and Graders
Owensboro Ditcher and Grader Co.

Drills
Sullivan Mchy. Co.

Dump Bodies, Steel
Mandt Body Co.
Providence Body Co.

Dump Wagons
Acme Road Mach. Co.
Austin-Western Road Mchy. Co.
Good Rds. Mchy. Co., Inc.
Standard Steel Wks.
Tiffin Wagon Co.

Engines
Flory Mfg. Co.

Excavators
Blaw-Knox Co.
The Baker Mfg. Co.
Hayward Co.
Pawling & Harnischfeger Co.

Explosives
E. I. du Pont de Nemours & Co.

Jacks, Lifting
The Duff Mfg. Co.

Lumber
E. J. Sterner Lumber Co.

Lumber (Creosoted)
Wyckoff Pipe&Creo.Co.,Inc.

Mixers
Acme Road Mchy. Co.
Blaw-Knox Co.
Jaeger Mch. Co.
Koehring Mch. Co.

Motor Trucks
Tiffin Wagon Co.

Paint
Dixon Crucible Co., Jos.

Piles (Creosoted)
Wyckoff Pipe&Creo.Co.,Inc.

Piling, Sheet Steel
W. A. Zelnicker Supply Co.

Plows
Wiard Plow Co.

Stand Pipes
Jas. McNeil & Bro. Co.

Poles (Creosoted)
Wyckoff Pipe&Creo.Co.,Inc.

Pumps
Acme Road Mchy. Co.
Emerson Pump & Valve Co.

Rails
W. A. Zelnicker Supply Co.

Snow Removal Outfits
The Baker Mfg. Co.
Holt Mfg. Co., Inc.

Structural Steel
American Bridge Co.

Switches
Koppel Industrial Car & Equipment Co.

Tackle Blocks
Atlantic Equipment Co.

Track
Koppel Industrial Car & Equipment Co.

Trailers
Smith & Sons Mfg. Co.

Turn Buckles
American Bridge Co.

Turn Tables
American Bridge Co.

Wire Rope
Leschen & Sons Rope Co.

Danger Signals
Ingram-Richardson Manufacturing Co.

FIRE DEPARTMENT EQUIPMENT

Combination Chemical and Hose Wagons
American-La France Fire Engine Co.

Fire Alarm System
Loper Fire Alarm Co.

Pumping Engines, Gasoline
American-La France Fire Engine Co.

Triple Combination Motor
American-La France Fire Engine Co.

PAVING AND ROAD MACHINERY

Asphalt Block Press
Nat'l Moulding Press Corp.

Asphalt Plants
Asphalt Pavement Retreading Co.
Cummer & Son Co.
Hetherington & Berner
Warren Bros. Co.

Car Unloaders
Acme Road Mchy. Co.
Good Rds. Mchy. Co., Inc.
Universal Road Machinery Co.

Concrete Mixers
Acme Road Mchy. Co.
Erie Mch. Shops
Good Rds. Mchy. Co., Inc.
Jaeger Mch. Co., The
Koehring Machine Co.
W. A. Zelnicker Supply Co.

Oil Distributors & Sprayers
Acme Road Mach. Co.
Austin-Western Road Machinery Co.
E. D. Etnyre Co.
Good Rds. Machy. Co., Inc.
The Kinney Mfg. Co.
Universal Road Mch. Co.

Pumps—Oil and Asphalt
The Kinney Mfg. Co.

Road Graders
Acme Road Mchy. Co.
Austin Western Rd. Mchy. Co.
The Baker Mfg. Co.
Good Rds. Mchy. Co., Inc.
Stockland Road Mach. Co.

Road Drags
Acme Road Mchy. Co.
Austin-Western Road Machinery Co.
The Baker Mfg. Co.
Good Rds. Mchy. Co., Inc.
Holt Mfg. Co., Inc.
Koehring Machine Co.
Stockland Road Mach. Co.

Road Levellers
Holt Mfg. Co., Inc.

Road Maintainers
Asphalt Pavement Retreading Co.
Austin-Western Road Machinery Co.
The Baker Mfg. Co.

Road Rollers
Acme Road Mchy. Co.
Austin-Western Road Machinery Co.
Buffalo-Springfield Rol'r Co.
Erie Mch. Shops
Good Rds. Mchy. Co., Inc.

Rock Crushers
Acme Road Mchy. Co.
Austin-Western Road Machinery Co.
Good Rds. Mchy. Co., Inc.

Rock Drills
Sullivan Mchy. Co.

Motor Tandam Rollers
Austin-Western Road Machinery Co.
Erie Mch. Shops

Scarifiers
Acme Road Mach. Co.
Austin-Western Road Machinery Co.
Buffalo-Springfield Rol'r Co.
Good Rds. Mchy. Co., Inc.
Holt Mfg. Co., Inc.
Stockland Road Mach. Co.
Universal Road Mchy. Co.

Scrapers
Acme Road Mach. Co.
Austin-Western Road Machinery Co.
The Baker Mfg. Co.
Good Rds. Mchy. Co., Inc.
Root Spring Scraper Co.
Smith & Sons Mfg. Co.

Screens
Acme Road Mach. Co.
Good Rds. Machy. Co., Inc.
Universal Road Mchy. Co.

Spreaders
Acme Road Mach. Co.
Burch Plow Works
Universal Road Mchy. Co.

Tar Kettles, Asphalt Heaters, etc.
Acme Road Mchy. Co.
The Kinney Mfg. Co.
Standard Steel Works
Warren Bros. Co.

Steel Forms
Heltzel Steel Form & Iron Wks.
Standard Steel Works
Truscon Steel Co.

PAVING MATERIALS

Asphalt
Pioneer Asphalt Co.
Standard Oil Co.
Texas Co.

Binders
Barrett Co., The
Standard Oil Co.
Texas Co.

Bituminous Pavements
Barrett Co., The
Texas Co.
Warren Bros. Co.
Willite Road Construction Company, Inc.

Creosoted Wood Block
Wyckoff Pipe&Creo.Co.,Inc.

Expansion Joints
Barrett Co., The
Truscon Steel Co.

Oil
Barrett Co., The
Headley Good Roads Co.
Republic Creosoting Co.
Standard Oil Co.
Texas Co.

Paving Brick
The Delaware Clay Products Co.

SEWERAGE

Culverts
The Delaware Clay Products Co.
Newport Culvert Co., The

Pipe (Cast Iron)
Nat'l Cast Iron Pipe Co.
Warren Foundry & Machine Co.

Pipe Cleaning Machines
W. H. Stewart

Pipe Joint Compound
The Ruberoid Co. (formerly The Standard Paint Company).
The Standard Paint Company (now The Rubberoid Co.

Ejectors
The Blackburn-Smith Corp.

Sewage Disposal Plants
C. P. Landreth
Sanitation Corporation

Sewage Disinfection
Electro Bleaching Gas Co.

Rods
The F. Bissell Co.
W. H. Stewart

Vitrified Fire Clay Sewer Tiles
East Ohio Sewer Pipe Co.
The Delaware Clay Products Co.

Vitrified Sewer Pipe
The Delaware Clay Products Co.

STREET CLEANING AND REFUSE DISPOSAL

Carts
Acme Road Mchy. Co.
Tiffin Waogn Co.

Manholes—Catch Basins
Wm. E. Dee Co.

Incinerators
Nye Oderless Crematory Company
Stacy-Bates Co.

Sprinkling Wagons and Flushers
Austin-Western Road Machinery Co.
E. D. Etnyre Co.
Good Rds. Mchy. Co., Inc.
The Kinney Mfg. Co.

Street Sweepers
Austin-Western Road Machinery Co.
Elgin Sales Co.
Universal Road Mchy. Co.

STREET SIGNS

Ingram-Richardson Co.

WATER WORKS

Air Compressors
Sullivan Machy. Co.

Air Lift Pumps
Sullivan Machy. Co.

Chloride of Lime
Penn Salt Mfg. Co.

Chlorine Liquid
Electro Bleaching Gas Co.

Deep Well Pumps
Cook, A. D.
Layne & Bowler Co.

Disinfecting Chemicals
Electro Bleaching Gas Co.
Penn Salt Mfg. Co.

Filters
N. Y. Continental Jewell Filtration Co.

Filtration Plants
Norwood Engineering Co.

Filter Alum
Du Pont de Nemours Co.

Fire Hydrants
Clark Co., H. W.

Flap Valves
Coldwell-Wilcox Co.

Meters
Badger Meter Mfg. Co.
Clark Co., H. W.
Hersey Mfg. Co.
Pittsburgh Meter Co.
Thompson Meter Co.
Union Water Meter Co.

Meter Boxes
H. W. Clark Co.
Ford Meter Box Co.
Pittsburgh Meter Co.

Meter Testing Machines
H. W. Clark Co.
Pittsburgh Meter Co.

Pipe, Cast Iron
National Cast Iron Pipe Co.
U. S. Cast Iron Pipe & Fdry. Co.
Warren Fdry. & Mach. Co.

Pipe, Steel
Jas. McNeil & Bro. Co.

Pipe, Wood
A. Wyckoff & Son Co.

Pumps
H. W. Clark Co.
Cook, A. D.
Sullivan Mchy. Co.
Layne & Bowler

Pumping Engines
Muncie Oil Engine Co.
Sterling Engine Co.

Screens for Wells
Cook, A. D.
Layne & Bowler Co.

Shear Valves
Coldwell-Wilcox Co.

Sleeves and Valves
Smith, A. P., Mfg. Co.

Sluice Gates
Coldwell-Wilcox Co.

Steel Stacks
Jas. McNeil & Bro. Co.

Strainers
Cook, A. D.

Tanks
E. D. Etnyre Co.
W. A. Zelnicker Supply Co.

Tapping Machines
Smith, A. P. Mfg. Co.

Valves
Clark Co., H. W.

Waste Detection
The Pitometer Co.

Water Main Cleaning
National Water Main Cleaning Co.

Water Purification
Electro Bleaching Gas Co.
N. Y. Continental Jewell Filtration Co.

Water Sterilization
Electro Bleaching Gas Co.

Water Supply from Well Systems
Cook, A. D.

Well Drills
Layne & Bowler Co.

See Alphabetical Index on last white page

WATER WORKS EQUIPMENT

LAMBERT

DISC METERS
For Big Buildings

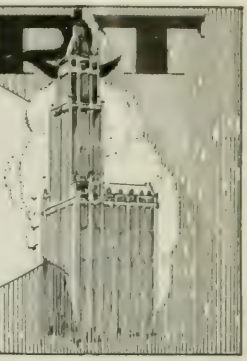
LAMBERT METERS

are being installed more and more every day in every big hotel and office building in the country.

It's because they are built to give long satisfactory service under exacting conditions that makes them so popular. Let us send you our bulletin telling the whole story.

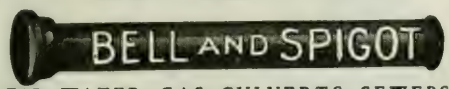
THOMSON METER CO.

100-110 Bridge Street Brooklyn, N. Y.



Manufacturers of

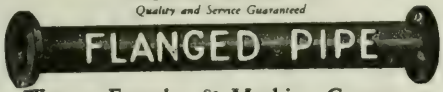
CAST IRON PIPE



FOR—WATER—GAS—CULVERTS—SEWERS

Also Flexible Joint Pipe—Cylinders—Tubes, Milled and Plain Ends—High Pressure Fire Service Pipe—Special Castings Flanged Castings a Specialty

Quality and Service Guaranteed



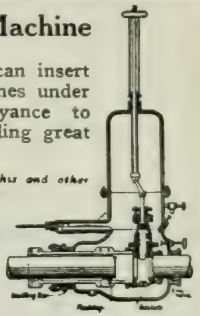
Warren Foundry & Machine Company

Offices, 11 Broadway, N. Y. 201 Devonshire St., Boston, Mass.
Works, Phillipsburg, N. J.

Valve Inserting Machine

With this machine you can insert new valves in existing lines under pressure avoiding annoyance to consumers and also avoiding great fire risks.

Write for complete description of this and other water works specialties



The A. P. SMITH MFG. CO.
East Orange, N. J.

CUMMER PORTABLE ROAD ASPHALT PLANTS (3 UNITS)

750, 1250 and 1800 yards 2 in. sheet asphalt daily or other standard mixtures

EASY CAPACITY OVER 200 IN OPERATION

CUMMER PLANTS NEVER WAIT FOR HOT SAND

THE F. D. CUMMER & SON CO.
CLEVELAND, OHIO

New York Offices:
No. 19 West 44th Street

NATIONAL CAST IRON PIPE CO., BIRMINGHAM, ALA.

PROMPT SHIPMENTS

SALES OFFICES:
(Write Nearest Office for Prices)

NATIONAL CAST IRON PIPE CO., Peoples Gas Building, Chicago
NATIONAL CAST IRON PIPE CO., Commerce Trust Bldg., Kansas City, Mo.

WATER PIPE—GAS PIPE

NATIONAL Pipe is made Right—on new equipment—by use of special cores.
NATIONAL Pipe has smoothest inside finish—easiest to work.

Send for complete information about The Blackburn-Smith

SEWAGE EJECTOR SYSTEM

The Blackburn-Smith Corporation, 109 Park Ave., New York

DIRECTORY OF CONSULTING ENGINEERS

Engaged in Municipal and Public Work

ALVORD, JOHN W.
BURDICK, CHAS. B.
Consulting Engineers

Reports, Investigations, Plans and Specifications for Water Supplies, Water Purification, Water Power, Sewerage, Sewage Disposal

Hartford Building, Chicago

THE AMERICAN APPRAISAL CO.

Milwaukee New York

Authoritative Reports and Valuations Covering Public Utility, Municipal, Mineral, Industrial, Commercial and Residence Properties.

BLACK & VEATCH
Consulting Engineers

Inter-State Bldg., Kansas City, Mo.

Sewerage, Sewage Disposal, Water Supply, Water Purification, Electric Lighting, Power Plants, Valuations, Special Investigations, Reports.

E. B. Black. N. T. Veatch, Jr.

BROSSMAN, CHAS.
Consulting Engineer

Merchants' Bank Building, Indianapolis, Ind. Water Supply. Sewerage and Disposal. Lighting Plants—Supervision of Construction and Operation. Appraisals—Expert Testimony.

BURNS & McDONNELL
Consulting Engineers

Appraisals — Expert Testimony
Sewerage — Rate Investigations
Water Works — Lighting

Clinton S. Burns R. E. McDonnell

Kansas City Inter-State Bldg.

CAIRD, JAMES M.
Assoc. Am. Soc. C. E.
Chemist and Bacteriologist

Office and Laboratory:
92 Fourth St., Troy, N. Y.

Water Analysis and Tests of Filter Plants

COLLINS, JOHN L.
Consulting Civil & Sanitary Engineer

Water Supply and PURIFICATION
SEWERAGE and SEWAGE DISPOSAL
Plans, Estimates and Supervision of Construction

30 Church Street, New York City

Before You Consult an Engineer

Look over the names of the men listed on this page.

Each one of them is an expert and is ready to offer advice on any subject in his line.

Wise cities recognize the fact that good advice costs less than mistakes, lawsuits or public disapproval.

The engineers whose cards appear here are prepared to place their years of demonstrated skill and efficiency at the disposal of cities who would build wisely.

DOW & SMITH
Chemical Engineers
Consulting Paving Engineers

A. W. Dow, Ph.B. F. P. Smith, Ph.B.
Mem. Am. Inst. Ch. Engrs.
Mem. Am. Soc. Civ. Engrs.

Asphalt, Bitumens, Paving, Hydraulic Cement, Engineering Materials

131-3 East 23d Street, New York

New York City · 2 Rector Street

A. E. HANSEN
Hydraulic and Sanitary Engineer

Design and Supervision of Construction

Sewerage — Water Works
Sewage Disposal — Water Purification
Drainage — Water Works Valuation
Garbage Disposal — Water Analysis

HAZEN, WHIPPLE & FULLER

Consulting Hydraulic and Sanitary Engineers, Water Supply, Sewerage, Drainage, Valuations, Supervisions of Construction and Operation.

ALLEN HAZEN G. C. WHIPPLE
W. E. FULLER L. N. BABBITT
C. M. EVERETT H. MALCOLM PIRNIE

30 East 42d Street, New York City

HILL AND FERGUSON
Consulting Engineers

Water Supply Sewage Disposal
Hydraulic Developments

Reports, Investigation, Valuations, Rates, Design, Construction, Operation, Management, Chemical and Biological Laboratories

112 E. 19th Street New York City

R. HUSSELMAN
Consulting Engineer

Design and Construction of Power Stations and Lighting Systems

Reports, Estimates and Specifications
Appraisals and Rate Investigations
Electric, Gas and Street Railway

CUYAHOGA BUILDING, CLEVELAND, O.

J. L. JACOBS & CO.
Industrial and Municipal Engineers

Investigations—Reports—Plans
Covering
Organization, Management, Accounting and Cost Methods. Employment and Wage Problems — Appraisals — Expert Testimony

Monadnock Building, Chicago

POTTER, ALEXANDER

50 Church Street, New York City

Civil and Sanitary Engineer

Specialties:
Water Supply, Sewerage and Pavements

The H & B Paving Brick Testing Machine

N. P. B. M. Standard Rattler

For the Testing of Paving Brick

As we now build this machine it embodies all of the

Latest Improvements

and refinements of construction that have been found desirable during a period of try out covering almost one year of time and conducted under the direction of the technical committee of the National Paving Brick Manufacturers' Association.

For descriptive circular and prices address

HETHERINGTON & BERNER
INDIANAPOLIS, Ind.

PITTSBURGH METER COMPANY

Water Meters for all Domestic and Industrial Services

East Pittsburgh, Pa.
New York
Chicago - Kansas City
Los Angeles - Seattle
Columbia, S.C.

THE X-RAY FOR PUBLIC WATER SYSTEMS

A PITOMETER SURVEY

will find all the underground service leaks, fixture leaks, closet leaks and the unnecessary waste of water.
Pays for itself many times over.
Write for particulars

The Pitometer Company
50 Church St. New York

CAST IRON PIPE

of all descriptions for Water, Gas, Sewerage, Drains, Culverts, Etc. Also Flanged Pipe, Flexible Joint Pipe, Special Castings, Large Cylinders and Heavy Castings. Quality and Service Guaranteed. Let us quote on your next requirements.

United States Cast Iron Pipe & Fdry Co. BURLINGTON, NEW JERSEY

SLUICE GATES

Shear, Flap and Butterfly Valves

FLEXIBLE JOINTS

COLDWELL - WILCOX CO.
Box 574 NEWBURGH, N. Y.

DECARIE INCINERATORS

FOR MUNICIPALITIES AND INSTITUTIONS
—ECONOMICAL AND SANITARY—
STACY-BATES COMPANY
MERKNIGHT BLDG SELLING AGENTS WRITE FOR LITERATURE MINNEAPOLIS

The Geiger Line

Drain and Stop Valves, Special Swing Gate Valves, Overflow and Relief Valves, Special Sluice Gates, Skimming Screens, Tide Gates.

These specialties have been installed all over Europe and are giving thorough satisfaction.

Apparatus, machinery and equipment for Water Filtration, Sewage Treatment, Garbage Reduction, Rubbish Destruction.

Ask for new bulletin describing these specialties

The Sanitation Corporation
165 Broadway New York City

APPROVAL

HERSEY DETECTOR METER

The Hersey Detector Meter has been accepted for thirteen years in 3" 4" 6" 8" 10" and 12" sizes without any restrictions or conditions of any kind by every Insurance Company Stock and Mutual, doing business in the United States, and by the Water Departments and Water Companies in more than 600 Cities and Towns for use on over 4,000 Fire Services protecting over $2,000,000,000 worth of Insured Property.

HERSEY MANUFACTURING COMPANY
BOSTON NEW YORK CHICAGO COLUMBUS, O PHILADELPHIA ATLANTA SAN FRANCISCO

INDEX TO ADVERTISEMENTS

A

	Page
Acme Road Machinery Co.	22
Alvord & Burdick	30
American Appraisal Co.	30
American Bridge Co.	4
American-La France Fire Engine Co.	27
American Tel. & Tel. Co.	—
Austin-Western Road Machinery Co.	7

B

Badger Meter Mfg. Co.	—
Baker Mfg. Co.	—
Barrett Co. The	—
Bissell Company, F.	—
Blackburn - Smith Corp., The	29
Black & Veatch	30
Blaw-Knox Co.	—
Brossman, Chas.	30
Brown Hoisting Machy. Co.	2
Burch Plow Works	—
Burns & McDonnel	30
Buffalo Springfield Roller Co.	25

C

Caird, James M.	30
Clark H. W. Co.	—
Coldwell-Wilcox Co	31
Collins, J. L.	30
Cook, A. D.	—
Cummer & Son Co., F. D.	29

D

Dee, Wm. E Co	—
Delaware Clay Products Co., The	25
Dixon Crucible Co., Joseph	—
Dow & Smith	30
Duff Mfg. Co. The	—
Du Pont de Nemours Co., E. I.	33

E

	Page
East Ohio Sewer Pipe Co.	28
Electro Bleaching Gas Co.	26
Elgin Sales Corp.	—
Emerson Pump & Valve Co.	—
Erie Mach. Shops	6
Etnyre & Co., E. D.	6

F

Flory Mfg. Co., S.	—
Ford Meter Box Co.	25

G

Galion Iron Works & Mfg. Co.	—
Good Roads Mach. Co., Inc., The	—
Granite Paving Block Association of U. S., Inc.	—
Gruendler Patent Crusher & Pulverizer Co.	32

H

Hansen, A. E.	30
Hayward Co.	—
Hazen, Whipple & Fuller	30
Headley Good Roads Co.	6
Heil Company	23
Hetzel Steel Form & Iron Co.	4
Hetherington & Berner	6, 31
Hersey Mfg. Co.	31
Hill & Ferguson	30
Holt Mfg. Co., Inc.	—
Husselman, R.	30

I

Ingram-Richardson Manufacturing Co.	27

J

Jacobs & Co., J. L.	30
Jaeger Mach. Co.	6
Jennings Automatic Dump Body, Inc.	—
Judy Manufacturing Co.	7

K

	Page
Kinney Mfg. Co.	23
Koehring Co.	—
Koppel Industrial Car & Equipment Co.	23

L

Landreth, C. P.	32
Layne & Bowler Co.	—
Leschen & Sons Rope Co., A.	25
Loper Fire Alarm Co.	—

M

Mandt Body Co.	—
Marine Metal & Supply Co.	26
McNeil & Bros. Co., Jas.	—
Mueller Mfg. Co.	—
Muncie Oil Engine Co.	—

N

Nat'l Cast Iron Pipe Co.	29
Nat'l Moulding Press Corp.	—
Nat'l Steel Fabric Co.	—
Nat'l Water Main Cleaning Co.	—
Newport Culvert Co.	—
New York Continental Jewel Filtration Co.	26
Norwood Engineering Co.	25
Nye Odorless Crematory Co.	—

O

Orton & Steinbrenner Co.	6
Oshkosh Mfg. Co.	—
Owensboro Ditcher and Grader Co.	5

P

Pacific Northwest Press Clipping Bureau	—
Pawling & Harnischfeger Co.	—
Penn. Salt Mfg. Co.	—
Pioneer Asphalt Co.	21
Pitometer Co.	31
Pittsburgh Meter Co.	19, 31
Portland Cement Assn.	—
Potter Alexander	30
Providence Body Co.	—

R

	Page
Ransome Conc. Machy. Co.	—
Republic Creosoting Co.	—
Root Spring Scraper Co.	32
Ruberoid Co. (formerly the Standard Paint Co.)	—

S

Sanitation Corporation	31
Smith, A. P. Mfg. Co., The	29
Smith & Sons Mfg. Co.	—
Stacy-Bates Co.	31
Standard Oil Co. (N. Y.)	—
Standard Paint Co. (now the Ruberoid Co.)	—
Standard Scale & Sup. Co.	5
Standard Steel Works	8
Sterling Eng. Co.	—
Sterner Co., E. J.	—
Stewart, W. H.	—
Steck and Road Machy. Co.	—
Sullivan Mach. Co.	—

T

Texas Co.	34
Thew Shovel Co.	—
Thomson Meter Co.	29
Tiffin Wagon Co.	—
Truscon Steel Co.	3

U

Union Water Meter Co.	32
U. S. Cast Iron Pipe & Fdy. Co.	31
Universal Road Machy. Co.	—

W

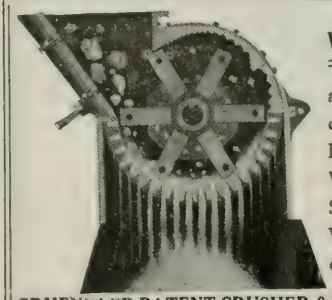
Warren Bros. Co.	21
Warren Fdy. & Mach. Co.	29
Wiard Plow Co.	21
Willite Rd Const. Co.	6
Wyckff Pipe & Creo. Co., Inc.	6
Wyckoff & Son Co., A.	—

Z

Zelnicker, W. A.	26

UNION WATER METER COMPANY
INC. 1868
Worcester Mass.
Send for Catalog 49

Direct Oxidation Process
APPARATUS FOR CARRYING OUT THIS PROCESS FOR SEWAGE AND WATER TREATMENT SUPPLIED UPON ENGINEERS' SPECIFICATIONS.
C. P. LANDRETH
15TH and LEHIGH AVE. PHILADELPHIA, PA.



We Manufacture
a complete line of Crushing Plants, Gravel Washing and Screening Plants. Write for further details.
GRUENDLER PATENT CRUSHER & PULVERIZER CO.
DEPT. P. ST. LOUIS, MO.

They Are Making Good

ROAD MAINTAINERS
Save $30.00 Per Day
Do 50 Per Cent Better Work
ROOT SPRING SCRAPER CO.
Kalamazoo, Mich.

WHEN YOU WRITE ADVERTISERS YOU WILL DO THEM AND US A FAVOR BY MENTIONING
PUBLIC WORKS

TD
1
P8
v.50

Public works

[redacted]
Physical &
Applied Sci
Serials

Engineering
Engineering

PLEASE DO NOT REMOVE
CARDS OR SLIPS FROM THIS POCKET

UNIVERSITY OF TORONTO LIBRARY

ENGIN STORAGE